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RENAL, URETERAL, PERIRENAL AND ADRENAL TUMORS AND ACTINOMYCOSIS AND ECHINOCOCCUS OF THE KIDNEY

RENAL, URETERAL, PERIRENAL AND ADRENAL TUMORS AND ACTINOMYCOSIS AND ECHINOCOCCUS OF THE KIDNEY

BY

EDGAR GARCEAU, M. D.

VISITING GYNECOLOGIST TO ST. ELIZABETH'S HOSPITAL, AND TO THE BOSTON DISPENSARY, BOSTON, MASS.; CONSULTING GYNECOLOGIST TO THE QUINCY CITY HOSPITAL, QUINCY, MASS.; MEMBER OF THE MASSACHUSETTS MEDICAL SOCIETY, THE BOSTON OBSTETRICAL SOCIETY, THE BOSTON SOCIETY FOR MEDICAL IMPROVEMENT, THE AMERICAN UROLOGICAL ASSOCIATION, THE AMERICAN MEDICAL ASSOCIATION, L' ASSOCIATION FRANCAISE D' UROLOGIE, PARIS, FRANCE; FELLOW OF THE AMERICAN GYNECOLOGICAL SOCIETY, ETC.

WITH SEVENTY-TWO ILLUSTRATIONS IN TEXT

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PREFACE

Great difficulty was met with in the preparation of this book in deciding upon a proper classification of tumors.

An attempt has been made to give in the text only that which has stood the test of the microscope. Many of the older tables of tumors of the kidney have been disregarded because it seemed to the writer that the classification used in these tables was hopelessly confusing.

Particular pains have been taken with the chapter on carcinoma, sarcoma, and adenoma of the kidney, and only a few of these tumors have been described, tumors which were at the disposal of the writer, and which were found in the Massachusetts General and Boston City Hospitals. These cases were most carefully studied at the hospitals mentioned by the regular corps of pathologists. The microscopic sections of the tumor have all been preserved, and the filed reports of the cases have been kept.

It has seemed best to the writer to adopt this method of studying tumors, because of the confused state of the pathology which, has enbarrassed authors.

Most of the microphotographs were taken at the Laboratory of the Massachusetts General Hospital.

While this work was in progress the writer was invited by Drs. F. S. Watson and J. H. Cunningham, Jr., of Boston, to write the chapter on renal tumors for their book entitled, Genito-Urinary Diseases, which has recently been published. Many of the illustrations appearing in this chapter, which were made from original specimens collected in the Boston Hospitals by the writer, are incorporated in the present work. The writer wishes to acknowledge his indebtedness to Messrs. Lea and Febiger, who published Drs. Watson and Cunningham's book, for their permission to use these illustrations again.

EDGAR GARCEAU.

397 Marlborough St.,
Boston, Mass.

42464

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CHAPTER I.

SOLID TUMORS OF THE RENAL PARENCHYMA

Most of the growths found in the kidney are of rare occurrence, and some of them are mere pathologic findings, giving rise to no symptoms during life. The destructive ones, however, are of great clinical interest and importance.

The folowing classification of renal tumors is offered:

SOLID TUMORS OF THE RENAL PARENCHYMA

Malignant.

1. Hypernephroma.
2. Carcinoma.
3. Sarcoma.
   - Round cell.
   - Spindle cell.
   - Fibrosarcoma.
   - Alveolar sarcoma.
   - Liposarcoma.
   - (Angiosarcoma)
4. Adenoma.

Benign.

1. Adenoma.
2. Angioma.
3. Lipoma.
4. Fibroma.

MALIGNANT TUMORS

By far the most important tumor affecting the kidney is the hypernephroma. It is of more frequent occurrence than any of the others, and its clinical course, on this account, is much better known. Of late years the pathologic investigations on this tumor have been wide-spread. Carcinoma, sarcoma, malignant adenoma, and adenocarcinoma, have been so persistently and frequently confounded with

hypernephroma in the published clinical reports of cases, and even in pathologic reports, as to make almost all of the material relating to these tumors of little value from a clinical and pathologic standpoint. These latter tumors are of much less frequent occurrence than hypernephroma.

It seems best, therefore, to discuss hypernephroma by itself, at the same time making prominent the fact that the symptoms and signs arising in consequence of this growth are very similar to those caused by carcinoma, sarcoma, and malignant adenoma.

Hypernephroma

Etiology

In estimating the comparative frequency of tumors affecting a given organ, it is evident that clinical data are of little value. It is essential that figures to be of any value at all should be compiled from pathologic records.

The following tables have been compiled from the pathologic records in both the Massachusetts General Hospital and the Boston City Hospital. In each of these hospitals there is a corps of trained pathologists who perform autopsies, and who have, during the past ten years, compiled an admirable set of records. Every autopsy has been performed with the greatest attention to detail, and all of the material of interest has been preserved in microscopic slides. The records, therefore, contain a valuable amount of information, which is open to the special student. An additional source of information is to be found in the surgical laboratory of the Massachusetts General Hospital, in which are records and microscopic slides of specimens which are obtained from the operating room. An examination of these specimens is made in this laboratory directly they are brought from the operating table, the specimen is permanently mounted, and a careful record is made of each. There were performed at the Massachusetts General Hos-

pital during the last ten years 1850 autopsies, and at the Boston City Hospital 1742, a total of 3592 autopsies. The surgical material at the Massachusetts General Hospital is obtained from a service of 150 active surgical heads. Every case has been personally examined by the writer and carefully studied. The nomenclature at the two hospitals has varied, as was natural, owing to the unsettled state in which this tumor finds itself. The writer has not hesitated, however, to classify as hypernephroma every tumor having the usual characteristics which have been generally agreed upon as distinctive of this tumor. Among these the most important are: large polyhedral cells, which are placed in close proximity to small capillary blood vessels; an occasional papillary arrangement in places; and an alveolar arrangement in places, the alveoli containing characteristic cells. In some instances the tumor has been classified as "angiosarcoma," "perithelioma," "endothelioma," etc., but as they all corresponded to the type outlined, it seemed best to classify them all under one head. Nevertheless, it has been thought best to give, in addition, the name which has been given at the two hospitals in classifying these tumors. It is to be remarked, however, that at both hospitals, the tumors most recently examined have all been frankly called "hypernephromata" when corresponding to the type outlined, and that the names "perithelioma," "sarcoma of adrenal origin," "endothelioma," etc., have been discarded. No tumor has been considered which was less than 4 cm. in diameter, and the great majority were of large size.

The most striking table is that compiled from material in the surgical laboratory connected with the operating room in the Massachusetts General Hospital. This material covers a period of time extending over eight years. The table is made up from actual cases of kidney tumors removed at operation, cases in which a diagnosis of renal tumor was made before operation. It is as follows:

	HYPERNEPHROMA OF THE KIDNEY.							*Classified as*:
No.	111.4	(Surg.	Lab.	Rec.,	M.	G.	H.)	"Sarcoma (perithelioma) of Adrenal Origin."
"	19.76	"	"	"	"	"	"	"Perithelioma of Adrenal Origin."
"	24.32	"	"	"	"	"	"	"Endothelioma."
"	31.12	"	"	"	"	"	"	"Sarcoma of Adrenal Origin."
"	33.90	"	"	"	"	"	"	"Alveolar Sarcoma from Adrenal Inclusion."
"	36.24	"	"	"	"	"	"	"Hypernephroma."
"	36.76	"	"	"	"	"	"	"Sarcoma of the Kidney."
"	37.44	"	"	"	"	"	"	"Adrenal Inclusion."
"	46.108	"	"	"	"	"	"	"Hypernephroma."
"	48.125	"	"	"	"	"	"	"Hypernephroma."
"	53.38	"	"	"	"	"	"	"Hypernephroma."
"	57.2	"	"	"	"	"	"	"Hypernephroma."
"	61.40	"	"	"	"	"	"	'Hypernephroma."
"	73.47	"	"	"	"	"	"	'Hypernephroma."
"	74.86	"	"	"	"	"	"	"Hypernephroma."
"	410.27	"	"	"	"	"	"	"Hypernephroma."
"	611.44	"	"	"	"	"	"	"Hypernephroma."

SARCOMA OF THE KIDNEY

No. S. 911. 7(Surg. Lab. Rec., M. G. H.-Spindle cell)

PAPILLARY ADENOMA OF THE KIDNEY

No. 78. 12(Surg. Lab. Rec., M. G. H.)

West Surg. Rec., Vol. 363, p. 196, M. G. H.

In this table there are seventeen large sized hypernephromata, two papillary adenomata, and one spindle cell sarcoma. It is to be noted that not a single case of carcinoma was operated upon during eight years' time. This is significant and makes of doubtful value many of the tables of "carcinoma" which have been compiled during the past decade.

By way of comparison it will be of interest to present Israel's table of renal tumors, also compiled from surgical material alone. Here again the hypernephroma prevails.

Israel's[1] table is as follows:

[1]Chir. Klin. d. Nierenkrankheiten, Berlin, 1901, p. 443.

Hypernephromata and endothelial adenomata..... 17
Carcinomata 8
Malignant papillary cystomata..... 4
Sarcomata 4
Mixed tumors—teratomata 2
Necrotic (?) tumors 2
Tumors which could not be definitely classified as epithelial 5
Papillary carcinoma of the renal pelvis..... 1

The following table comprises all the tumors affecting the urinary tract. It has been compiled from cases both from the autopsy room and from the operating room in the Massachusetts General Hospital and the Boston City Hospital during a period of ten years:

I. SOLID ADRENAL TUMORS.

Benign Hypernephroma (classified as Adenoma.)

No. 98.55. (Autop. Rec., B. C. H.).

Malignant Hypernephroma.

No. 1078 (Autop. Rec., M. G. H.)
" 1230 (Both adrenals). (Autop. Rec., M. G. H.)
" 1270 (Autop. Rec., M. G. H.)

II. PERIRENAL TUMOR.

Sarcoma.

No. S.01.495 (Large mass around the kidney involving the latter organ). (Surg. Lab. Rec., B. C. H.)

III. TUMOR OF THE RENAL PELVIS AND URETER.

Papilloma of the Renal Pelvis.

No. S.02.754 (Surg. Lab. Rec., B. C. H.)

IV. SOLID TUMORS OF THE RENAL PARENCHYMA.

Hypernephroma (Large tumors).		*Classified as*:
No. S.99.77	(Surg. Lab. Rec., B. C. H.)	"Malignant adenoma of adrenal origin"
" S.99.480	" " " " " "	"Adenoma of adrenal origin."
" 00.80	(Autop. Rec., B. C. H.)	"Adrenal tumor of the kidney.
" S.00.769	(Surg. Lab. Rec., B. C. H.)	"Adrenal tumor of the kidney—(malignant adenoma)."

No.	S.03.46	(Surg. Lab. Rec., B. C. H.)	"Hypernephroma."
"	S.03.75	" " " " " "	"Hypernephroma."
"	S.03.361	" " " " " "	"Hypernephroma."
"	04.181	(Autop. Rec., B. C. H.)	"Hypernephroma."
"	S.04.940	(Surg. Lab. Rec., M. G. H.)	"Adrenal carcinoma."
"	05.139	(Autop. Rec., B. C. H.)	"Hypernephroma."
"	19.76	(Surg. Lab. Rec., M. G. H.)	"Perithelioma of adrenal origin."
"	111.4	" " " " " "	"Sarcoma (perithelioma) of adrenal nal origin."
"	24.32	" " " " " "	"Endothelioma."
"	31.12	" " " " " "	"Sarcoma of adrenal origin."
"	33.90	" " " " " "	"Alveolar sarcoma from adrenal inclusion."
"	36.24	" " " " " "	"Hypernephroma."
"	36.76	" " " " " "	"Sarcoma of the kidney."
"	37.44	" " " " " "	"Adrenal inclusion."
"	46.108	" " " " " "	"Hypernephroma."
"	48.125	" " " " " "	"Hypernephroma."
"	53.38	" " " " " "	"Hypernephroma."
"	57.2	" " " " " "	"Hypernephroma."
"	61.40	" " " " " "	"Hypernephroma."
"	73.47	" " " " " "	"Hypernephroma."
"	74.86	" " " " " "	"Hypernephroma."
"	410.27	" " " " " "	"Hypernephroma."
"	611.44	" " " " " "	"Hypernephroma."
"	237	(Autop. Rec., M. G. H.)	"Alveolar sarcoma."
"	279	" " " " "	"Carcinoma, kidney and adrenal."
"	960	" " " " "	"Hypernephroma."
"	1049	" " " " "	"Hypernephroma."
"	1272	" " " " "	"Hypernephroma."
"	1325	" " " " "	"Hypernephroma."

Besides this list of hypernephromata, there may be appended an additional list of hypernephromata of small size, tumors, however, which were readily appreciated by the

eye but which were not large enough to give rise to clinical symptoms. The size averaged from 2 to 4 mm. in diameter.

This list is as follows:

Small Hypernephromata. *Classified as*:

No. 461	(Autop. Rec., M. G. H.)	"Hypernephroma."
" 844	" " " " "	"Hypernephroma."
" 870	" " " " "	"Hypernephroma."
" 990	" " " " "	"Hypernephroma."
" 991	" " " " "	"Hypernephroma."
" 1044	" " " " "	"Hypernephroma."
" 1088	" " " " "	"Hypernephroma."
" 1142	" " " " "	"Hypernephroma."
" 1267	" " " " "	"Hypernephroma."
" 1356	" " " " "	"Hypernephroma."
" 1663	" " " " "	"Hypernephroma."
" 1721	" " " " "	"Hypernephroma."

Carcinoma.

No. S.04.768 (Surg. Lab. Rec., B. C. H.)
" S.05.901 " " " " " "

A case related to the writer by Dr. E. H. Nichols (See Fig. 13, p. 115.)

Adenoma.

No. 06.111 (Malignant papillary cystadenoma—Classified as "Carcinoma" of the kidney.)
" 98.55 (Autop. Rec., B. C. H.)
" 78.12 (Papillary adenoma.) (Surg. Lab. Rec., M. G. H.)

West Surg. Rec., Vol. 363, p. 196, M. G. H. (Papillary adenoma.)

Small Papillary Adenomata—Autopsy findings.

No. 231	(Autop. Rec., M. G. H.)
" 245	" " " " "
" 285	" " " " "
" 315	" " " " "
" 519	" " " " "
" 793	" " " " "
" 825	" " " " "
" 843	" " " " "
" 1152	" " " " "
" 1378	" " " " "

The small papillary adenomata referred to in this table were mere pathologic findings, but the large ones were of considerable size, and gave rise to pronounced clinical symptoms.

Sarcoma.

No. S.06.251 (Large round cell). (Autop. Rec., B. C. H.)

" S.911.7 (Large spindle cell). (Surg. Lab. Rec., M. G. H.)

Fibroma.

No.	00.12	(Small).	(Autop.	Rec.,	B.	C.	H.)
"	00.41	"	"	"	"	"	"
"	00.183	"	"	"	"	"	"
"	01.180	"	"	"	"	"	"
"	02.4	"	"	"	"	"	"
"	05.124	"	"	"	"	"	"
"	05.157	"	"	"	"	"	"
No.	230	"	(Autop.	Rec.,	M.	G.	H.)
"	324	"	"	"	"	"	"
"	392	"	"	"	"	"	"
"	913	"	"	"	"	"	"
"	1005	"	"	"	"	"	"
"	1241	"	"	"	"	"	"
"	1839	"	"	"	"	"	"

The fibromata were, without exception, of very small size, averaging not over a few millimeters in diameter. Most of them were found underneath the capsule of the kidney, in the cortex, but one of them, (No. 1839, Path. Rec., M.G.H.), had a most curious position in one of the pyramids of the renal pelvis.

Lipoma.

No. 00.51 (3 mm. in diameter, in the cortex of the kidney; the sole specimen in the Boston City Hospital in ten years). (Autop. Rec., B. C. H.)

"	1007	(Small.)	(Autop.	Rec.,	M.	G.	H.)
"	1349	"	"	"	"	"	"
"	1418	"	"	"	"	"	"
"	1647	"	"	"	"	"	"

Arranged in tabular form these tumors may be thus classified:

Benign Hypernephroma of the Adrenal	1
Malignant Hypernephroma of the Adrenal	3
Perirenal sarcoma	1
Papilloma of the renal pelvis	1
Hypernephroma of the kidney parenchyma (large)	33
Hypernephroma of the kidney parenchyma (small)	12
Carcinoma of the kidney parenchyma	3
Papillary cystadenoma of the kidney parenchyma (large)	4
Papillary adenoma of the kidney (small)	11
Sarcoma of the kidney parenchyma (round cell)	1
Sarcoma of the kidney parenchyma (spindle cell)	1
Fibroma	14
Lipoma	5
	90

Reckoning the malignant tumors, we have 33 hypernephromata of large size and of distinctly malignant type, 3 carcinomata, 2 sarcomata, and 4 malignant papillary adenomata.

Carcinoma of the pure type is a tumor of extreme rarity in the kidney, and the writer must insist, from his personal investigations, that the tumor most commonly found in the kidney is that derived from adrenal "rests." The minute structure of this tumor will be found in the section on the pathology of hypernephroma.

The figures given are distinctly at variance with many figures already published. Thus, Albarran and Imbert[1] give the following table of renal tumors in adults compiled from a list of 380 cases. The authors admit, however, that, owing to the confusion which has existed in regard to these tumors, the table has little value.

Adenomata	10
Epitheliomata	188
Hypernephromata	85
Sarcomata	82
Mixed tumors	10
Fibromata	2

[1]Tumeurs du Rein, Paris, 1903, p. 16.

Lipomata	2
Teratomata	1
	380

Albarran and Imbert, however, regard the pathology of hypernephroma in a different light from that of most authors. Many of their tumors which appear to have the distinctive characteristics of hypernephroma, they insist on regarding as epitheliomata (épithéliomes à cellules claires) or adenomata (adénomes à cellules claires), according as they are malignant or benign in their clinical course; and they believe that these tumors, which, from their description do not appear to differ from the hypernephroma, are true epitheliomata or adenomata, and they futhermore assert that both these tumors may be derived either from the renal epithelium or from aberrant adrenal "rests[1]". The authors admit[2] that the tumors in question, both malignant and benign, have a most striking resemblance to that form of tumor ordinarily admitted to be hypernephroma.

An additional source of confusion consists in classifying under "sarcoma" tumors described by other authors as "angiosarcoma" and "endothelioma". These tumors, Albarran and Imbert[3] admit, differ radically from the ordinary form of sarcoma in every particular. A careful perusal of the text in their book and a glance at their illustrations cannot help giving the impression that the tumor described as "angiosarcoma" very much resembles the hypernephroma. These authors,[4] in concluding their remarks on these tumors, say, "the angiosarcoma and the endothelioma, etc.," meaning tumors having characteristics like these two, "are allied in part to the epitheliomata with clear transparent cells, and in part to tumors which take their origin from suprarenal "rests." It is evident, therefore,

[1]Les Tumeurs du Rein, Paris, 1903, p. 203.
[2]Loc. cit., pp. 26 and 27.
[3]Loc. cit., p. 203.
[4]Loc. cit., p. 207.

that there is considerable doubt in their minds as to the exact place these tumors should take in tumor classification.

Kelynack[1] admits the confusion which exists between growths arising from adrenal inclusions and the various forms of carcinoma. Kelynack, however, recognizes the "angiosarcoma" of De Paoli, but makes no mention as to the possibility of its being confounded with hypernephroma. He speaks of the alveolar sarcoma and comments on its close similarity to the tumors usually called "endothelioma" and "angiosarcoma." Kelynack[2] admits that there has been great confusion with regard to tumors derived from suprarenal "rests" and he states that it is undoubtedly true that most of the tumors classified as renal "sarcomata" are in truth derived from adrenal "rests."

Kelynack's[3] table of tumors is as follows:

Sarcomata	115
Myosarcomata	22
Carcinomata	142
Fibromata, Lipomata, Mixed tumors	15
Adenomata	12
	306

These tumors occurred in individuals of all ages, young and old. Kelynack frankly admits that the table has no real value, for he says that many of the tumors classed as "cancers," he considers to be sarcomata.

Morris[4] briefly reviews the various opinions held by different authors. He comments on the uncertain state of the pathology of renal growths, especially the hypernephroma. Morris gives no table regarding the comparative frequency of hypernephroma, but he quotes Bayard Holmes as saying that one third of all renal tumors are of the type which take

[1] Renal Growths, London, 1898, p. 58.
[2] Loc. cit., p. 132.
[3] Loc. cit., p. 20.
[4] Surgical Diseases of the Kidney and Ureter, London, 1901, p. 552.

origin in adrenal "rests." Morris[1] is of the opinion that too many tumors have been relegated to this class. In speaking of carcinoma he gives no figures of his own as to the frequency of this form of growth, but he refers to Guillet's twenty-eight cases of "carcinoma." This latter author wrote twenty years ago[2]. Morris[3] is inclined to believe that epitheliomata are of comparatively frequent occurrence, for he says: "It is impossible to deny that tumors of the kidney do occur which there is every reason to believe arise from the aberrant suprarenal nodules. At the same time we admit that the great majority of renal epitheliomata spring from the epithelium of the renal tubules, and it can be shown that gradations of changes are traceable from the normal tubes to adenoma and epithelioma." It is evident that Morris is influenced by the opinions of Albarran and Imbert.

Tables compiled by other writers show similar uncertainty. A careful study of the tumors described in various books and monographs, and called by different authors, "perivascular sarcoma," "venous endothelioma," "lymphatic endothelioma," "epithelioma with clear transparent cells," "adenoma with clear transparent cells," reveals the fact that they all without exception bear a striking likeness to the tumor now generally called hypernephroma. This great diversity of names has undoubtedly originated from the desire of the individual authors to give a name to the tumor which should convey some idea as to what each author considered the true pathogenesis of the growth to be. There seems to be no good reason why all these names should be retained and it would be much simpler that they should be discarded and that all these tumors should be included under one name, hypernephroma. This will be discussed at greater length in the section on the pathology of hypernephroma.

[1]Loc. cit., p. 551.
[2]Guillet; Thèse de Paris, 1888.
[3]Loc. cit., p. 572.

The *age* at which hypernephroma is likely to appear may be seen by a glance at the following table, which was compiled from a series of 176 cases of hypernephroma collected from various sources in literature:

Age.	*No. of Cases.*
1—10	4
10—20	0
20—30	10
30—40	17
40—50	48
50—60	61
60—70	24
70—80	3
Age not stated	9
Total	176

The youngest patient was Cheeseman's[1], a male child, a year and a half old, who had a tumor weighing four and one-half pounds removed and who recovered. The oldest was Driessen's[2], a male seventy-nine years of age. Most of the cases occurred in individuals between the ages of fifty and sixty; the decade next in order of frequency was that between forty and fifty. There were none over eighty and none between ten and twenty. It is worthy of note that four of the cases were in patients under the age of ten years (See Cases 40, 59, 69, and 155, in table on page 84-108. One of the most remarkable cases occurring in this decade was Clairmont's[3], that of a child a year and nine months old in whom the disease was complicated by a horse-shoe kidney.

Males are more prone to the disease than females. Keen, Pfahler, and Ellis[4] collected 157 cases of hypernephroma, of which 71 were in males and 45 in females. In the cases compiled by the writer, there were 102 males, 71 females, and in three the sex was not stated.

[1]Ann. Surg., 1907, Vol. 45, p. 91.
[2]Ziegler Beitrag, 1893, Vol. 12, p. 106.
[3]Arch, f. klin. Chir., 1896, Vol. 79, p. 684.
[4]Am. Med., 1904, Vol. 8, p. 1047.

The right side is a little more frequently affected than the left one, and 82 cases are recorded in which the disease occurred on the right, 77 on the left, and in 17 the side was not stated. The reason for the greater prevalence on the right side is probably to be sought in the causes which determine a greater frequency of kidney affections on this side.

The growth is very rarely bilateral and when both kidneys are affected it is probable that one is to be looked upon as the seat of a secondary deposit. In only three of the tabulated cases were both kidneys affected by disease.

There is very little evidence that a blow received in the region of the kidneys has much, if anything, to do with the etiology of this affection. In very few of the reported cases is there any history, recent or remote, of injury. Blows are very frequently received in the region of the kidney, and it is very doubtful if they have anything to do with the causation of this disease. This, however, is certain, that a blow may start up a hemorrhage in a kidney which has been affected for some time and which up to the time of the receipt of the injury has been latent and has given rise to no symptoms whatever. The blow in this way calls attention to the disease and is given more prominence than is warranted.

There is some evidence that blows, which have injured bones in different parts of the body, may have some influence in causing metastases to appear in those particular bones; thus, Lowenhardt[1] relates a case in which trauma of the left elbow was subsequently followed by a metastatic deposit of hypernephroma in this location.

Heredity appears to have but little weight in the etiology of this disease. Albarran and Imbert[2] in a list of 412 renal tumors of malignant type found only 5 cases in which heredity seemed to be a predisposing cause.

A number of cases of malignant disease of the kidney

[1]Dtsch. Zeit. f. Chir., 1888, Vol. 28, p. 584.
[2]Les Tumeurs du Rein, Paris, 1903, p. 221.

have been reported in which there was but a single kidney in the body, and this fact has been suggested as an etiologic factor in the causation of the disease. Possibly the added work which the single kidney is obliged to perform may have something to do with the growth and development of prenatal adrenal "rests." The writer has in mind one case which was under his observation for a while in which a large hypernephroma affected a single kidney.

Pathology

In 1883, Grawitz[1] for the first time gave an accurate description of a tumor occurring in the kidney, which had before that time been erroneously supposed to be an example of lipoma. This wrong interpretation of the nature of this growth has been due to the fact that it was frequently of a yellow color, suggesting lipomatous tissue, and also due to the fact that, before Grawitz's time, no one had accurately observed the perfectly characteristic microscopic structure of the growth, which at once distinguished it from all other kinds of kidney tumors. Grawitz gave it the name "*struma lipomatodes aberrantae renis.*" and was very firm in his views in regard to the origin of this tumor. His conclusion, which he arrived at by a most careful and critical study of the growth, was that the tumor originated from aberrant adrenal tissue which is so frequently found in the kidney. This view has been disputed by a large number of observers, but, as will be seen, the arguments brought forward to prove the truth of Grawitz's assertion are so strong that there are today but few objectors to it.

The question as to the origin of these growths excited not nearly as much discussion as did the question as to what the growth really was. There are many now who insist on calling the tumor an adenoma, others insist that it is a carcinoma, others that it is an endothelioma, while others are equally positive that it can be nothing but a sarcoma.

[1]Virch. Arch., 1883, Vol. 93, p. 39.

This point is just as obscure to-day as it was many years ago, and as a compromise it has been generally agreed that the tumor shall not be given a definite name which would serve to classify it as a tumor of known histogenesis, but that in order to classify it some distinctive name shall be given to it which shall serve to indicate its present position in tumor classification. The name "hypernephroma," first suggested by Lubarsch[1], which signifies tumor derived from the adrenal, is the name which has been given to it until its exact position and classification shall have been determined.

There is abundant evidence that the tumor may remain latent for many years in the kidney and not occasion any symptoms whatever. In these cases the growth remains of small size and does not interfere with the function of the kidney. Such are the small growths a few millimeters in diameter which are found at autopsy. When the growth is a little larger, even though it does not give rise to symptoms, it may be source of origin of metastases which are the cause of death. This is not of very infrequent occurrence as clinical histories and pathologic reports abundantly confirm. In early life small tumors must be looked for with care, for the growth may not be larger than a small pea or a lentil. These small growths are to all intents and purposes perfectly benign and yet they are potentially malignant.

The smaller growths histologically suggest the structure of the cortex of the adrenal, while the larger ones assume more and more the types of sarcoma, adenoma, and carcinoma. That there is a relation between the smaller and the larger ones is perfectly evident from the fact that the larger growths also contain structures recalling the adrenal cortex. It should be said, however, that the normal adrenal tissue is almost never met with in these growths, and some observers claim that it is never seen. This tumor is one of the best illustrations of the Cohnheim theory of cell in-

[1]Virch. Arch., 1894, Vol. 135, p. 195.

clusion as bearing on the origin of new growths, and this tumor has been brought forward by the adherents of this theory as a proof of its correctness.

Most of these tumors are found in the upper pole of the kidney, and their situation is immediately beneath the capsule, although in some instances the growth may be in the medullary portion. The lower pole, however, or the middle part of the kidney may be attacked. There is a capsule which surrounds the tumor and sharply marks it off from adjacent renal tissue. The tumor may consist of a single nodule or there may be several. The usual color of the growth is yellow, but it may be grayish, red brown, or bluish, or even black in areas where there has been hemorrhage. The consistence in most cases is soft, but it may at times be firm, and the tumor is generally sharply outlined. The size of the growth is sometimes quite considerable, and it may be as large as the adult head. If hemorrhage has been abundant, there may be softening and cyst formation, and in these cases the tumor presents a cystic appearance. The kidney changes in the vicinity of the tumor are in the nature of atrophy and interstitial nephritis.

It is the generally accepted opinion to-day that all hypernephromata should be reckoned malignant, even the apparenly benign ones, because the latter may, at any time, assume malignant characters, give rise to metastases and end in death. Many authors have called this tumor a border-line tumor between benign and malignant growths. The benign ones may be called potentially malignant because they may give rise to destructive metastases. As Von Hansemann[1] observes: "Every hypernephroma of the kidney is malignanat; just as there are carcinomata which remain for years without growing or forming metastases, so also there are relative harmless periods in the history of hypernephroma."

On microscopic examination, the smaller growths ex-

[1]Zeit. f. klin. Med., 1902, Vol. 44, p. 9.

hibit a structure which markedly recalls the structure of the normal adrenal. This may properly be called the first stage of the growth of a hypernephroma. There is a network of capillaries, which constitutes the stroma of the tumor, and upon these capillaries, arranged sometimes in palisade form, situated close to their walls, without intervening tissue, the cells of the growth are arranged (Figs, 1-2-3). The appearance of the growth as a whole recalls

Fig. 1.—Hypernephroma of the Kidney, showing Papillary Arrangement of the Cells. These Cells are arranged around Capillaries. From the Lab'y at the Harvard Medical School.

most markedly the arrangement seen in a normal adrenal cortex.

It is the stroma formed of capillaries which is the most distinctive feature, and it is this feature which has given rise to the opinion of some observers that the growth must be essentially an endothelioma or an angiosarcoma. The arrangement of cells on the capillaries is in rows, sometimes two or three deep. The cells are not only found arranged along the capillary network, but they may also be

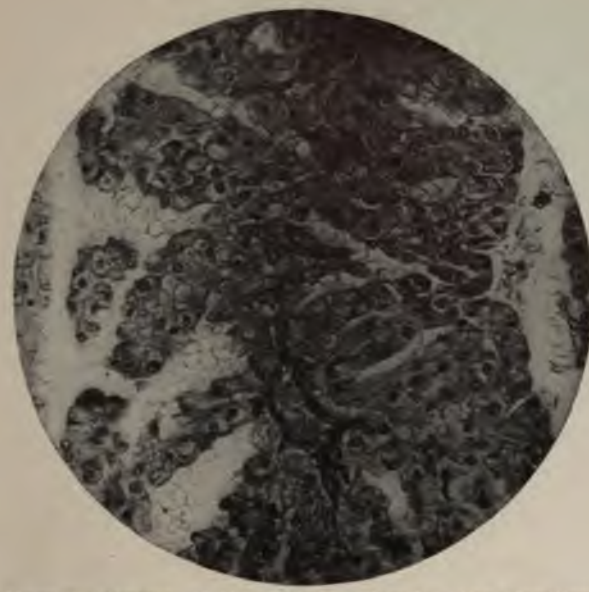

Fig. 2.—Hypernephroma of the Kidney, showing the Papillary Arrangement of the Cells. These cells are clustered around small Capillaries. From the Lab'y at the Boston City Hospital.

Fig. 3.—Hypernephroma of the Kidney, showing the Papillary Structure. From the Laboratory at the Boston City Hospital.

found in the meshes of the capillary network lying free. Giant cells are sometimes seen, and karyokinetic figures are occasionally observed. The blood vessels are sometimes normal in appearance, and in other places they appear collapsed. There is no connection whatever between the tumor cells and the urinary tubules. The structure of the cells constituting the growth is most striking in that it resembles most closely the cells of the normal adrenal cortex. They are polygonal in outline, slightly larger than the normal adrenal cell, and furthermore they contain a large amount of infiltrated fat, a feature which is commonly observed in the adrenal of the adult. Glycogen has also been found in these cells, and glycogen is always present in tumors of the adrenal. It cannot, however, be said that the presence of glycogen is characteristic of this growth, because glycogen has likewise been found in growths of a different nature. Lecithin has also been found in these growths, and in amounts equal to that found in the suprarenal tissue. The larger tumors exhibit a prominent feature. This is the arrangement of the polygonal cells in distinct alveoli, and it is this alveolar arrangement which has given rise to the opinion that the growth is a carcinoma or an alveolar sarcoma. The alveolar arrangement is also seen in the small growths. The stroma of the tumor is still made up of blood vessels, but there is in addition in some parts a certain amount of fibrous tissue (Figs 4-5). In some of the alveoli the tumor cells may be seen resting on capillary walls surrounding the alveolus, in a manner similar to that seen in the papillary form. In the larger growths the columns of cells arranged on the capillaries in palisade form are much thicker, and palisades are formed with numerous cells which are larger or smaller. It is far more frequent to observe the alveolar arrangement, in a series of microscopic slides, than the papillary; thus, in a series of 36 mounted specimens of hypernephroma, the writer observed the alveolar type alone, 22 times, and the alveolar and papillary

Fig. 4.—Hypernephroma of the Kidney, showing the Arrangement of the cells in Alveoli. From the Lab'y at the Boston City Hospital.

Fig. 5.—Hypernephroma of the Kidney, showing Typical Cells of Polygonal Shape, contained in Alveoli. Greatly Magnified. From the Lab'y at the Boston City Hospital.

types together, 14 times. Here and there blood spaces may be seen, which probably arise through ectasia of the capillaries. In other parts there are small cysts which are probably due to dilated lymph vessels. The richest blood supply is always at the periphery. Areas of necrosis are occasionally apparent.

In these large tumors the medullary portion of the adrenal is sometimes, though rarely, seen. Ohlmacher[1] gives a typical case of this kind. Ohlmacher noted the "disposition of the reticulum which by anastomosis forms round, oval, or elongated alveolar spaces filled with characteristic cells, recalling the reticulum of the adrenal medulla of the dog. There were also embryonic or immature medullary cells beneath the capsule of the tumor, and everywhere penetrating into the deeper portions, at the same time undergoing transition as seen in the developing normal adrenal." Bierring and Albert[2] likewise describe a case of the same kind in a child five years old. The absence of medullary elements in most of these tumors is explained by the fact that the medullary portion of the adrenal is almost never present in accessory adrenals[3].

Inflammation, which leads to abscess of the growth or of the perirenal tissues, is of the rarest occurence. When it occurs there is usually some exciting cause other than the tumor.

The disease is disseminated in two ways, by extension to contiguous structures and by metastasis.

The renal vein is frequently invaded by the growth and thrombosis results. A long thrombus sometimes forms which may even extend as far as the auricle of the heart. Loosened emboli sometimes find their way to the heart and lungs, disseminate the disease here, or cause sudden death. Rarely does the disease attack surrounding structures but

[1]Tr. Chi. Path. Soc., 1901-03, Vol. 5, p. 86.
[2]Jour. Am. Med. Ass., 1904, Vol. 43, p. 236.
[3]See Poll-Hertwig-Handbuch der Vergl. und. Exper. Entwickelungslehre der Wirbeltiere, Jena, 1906, p. 583.

this sometimes does occur. In Böhler's[1] case the adrenal of the same side was attacked, and so likewise did this happen in the case operated upon by Dr. G. H. Monks[2]. Very rarely does extension take place in the ureter. Shattuck and Harrington[3] report such a case, however, in which the disease had invaded the ureter and had caused a thickening which could be appreciated as far as the pelvic brim. The

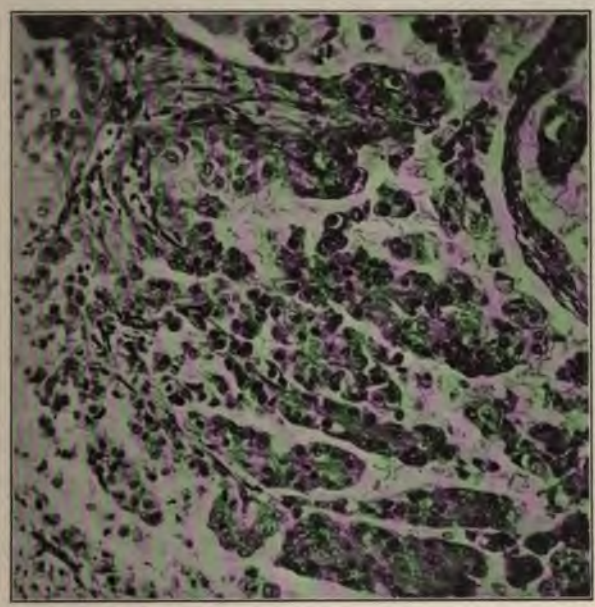

Fig. 6.—Metastasis in the Lung of Hypernephroma of the Kidney. The lung infundibulum is filled with papillary tumor masses. From the Lab'y at the Harvard Medical School. No. 3141.

writer has seen a precisely similar case in his own practice. There is also another case of the same kind, the notes of which may be found in the Surgical Laboratory of the Massachusetts General Hospital (61.40).

The metastases of this growth are interesting. They reproduce exactly in their minute structure the characteristics of the parent tumor. They are most often found in the bones and lungs. The disease is disseminated from the

[1]Wien. klin. Woch., 1903, Vol. 16, p. 553.
[2]Boston City Hosp. Rec., Vol. 329, p. 240.
[3]Boston Med. and Surg. Jour., 1906, Vol. 154, p. 270.

original source mainly by the blood current and not by the lymphatic system, as is the case with carcinoma. Occasionally, however, the lymphatics spread the disease, and in these cases the glands are found swollen. In the rare instances of glandular involvement, the regional glands are the ones implicated and occasionally those of the inguinal region. When the long bones are affected by the disease, spontaneous fracture may result, and if the spinal column is attacked, paralysis below the point of disease is the result. No part of the body is free from the danger of metastasis; thus, the brain, bronchi, lungs (Fig 6), diaphragm gluteal region, heart, (Fig. 7), intestines, liver, thoracic duct (Fig. 8), omentum, pancreas, pleura, peritoneum, skin, uterus, etc., have all been reported as having been the seat of metastases. Not very infrequently the disease returns in the scar of the wound made years before at the nephrectomy. Clairmont[1] records a remarkable case in a male thirty-nine years of age, who had had a nephrectomy performed ten years previously. He died, and at the autopsy the disease was found in the peribronchial glands. Clairmont supposed that infection had occurred through a small opening accidentally made in the diaphragm at the time of operation. The bone metastases are by far the most interesting. Sometimes the metastasis is the first symptom of the disease. It may happen that the disease may run its whole course and the bones be the only parts of the body involved together with the kidney. Albrecht[2], in a list of fourteen cases in which the site of metastases was accurately determined, found bone involvement in eight cases and lung involvement in seven. All parts of the skeleton were attacked, including the long, the short, and the flat bones. Albrecht has never seen spreading of the disease along the urinary tract (27 cases). Occasionally the disease runs its whole course without giving rise to a single

[1]Archiv. f. klin. Chir., 1904, Vol. 79, p. 620.
[2]Verh. d. Dtsch. Ges. f. Chir., Berlin, 1905, Vol. 34, p. 662.

Fig. 7.—Metastasis in the Myocardium, from a case of Hypernephroma of the Kidney.
From the Pathological Laboratory, Harvard Medical School.

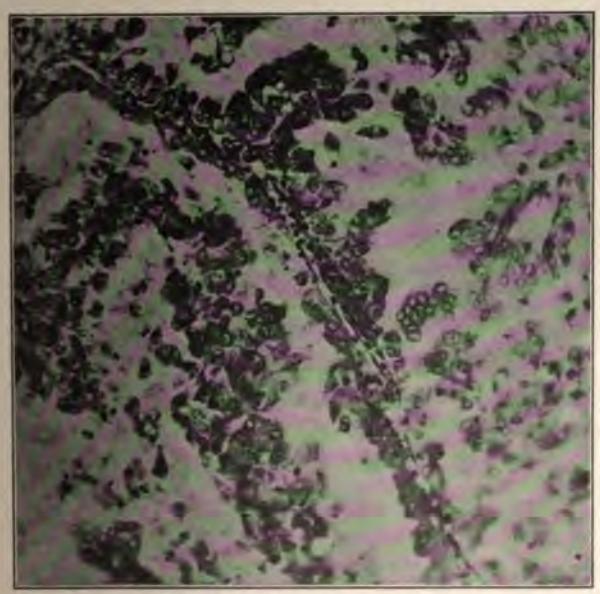

Fig. 8.—Metastasis of Hypernephroma of the Kidney in the Thoracic Duct, showing long branching papillae composed of Capillaries surrounded by Tumor Cells. From the Lab'y at the Harvard Medical School.

metastasis. Israel[1] records such a case and there are some others in the literature.

The following list compiled from 176 cases of hypernephroma possesses only a relative value because in most instances the reports were clinical, and it could not be stated positively that there were no hidden metastases. The list, however, gives a fairly good idea of the localities in which metastases are likely to occur and it also gives the comparative frequency with which special organs are attacked.

METASTASES OF HYPERNEPHROMA.

Axilla	2
Abdominal wall	1
Adrenal, same side	1
Adrenal, opposite side	1
Bladder wall	1
Brain	4
Bronchi	1
Clavicle	2
Diaphragm	1
Femur	7
Frontal bone	2
Gluteal region	1
General Metastasis	6
Humerus	2
Heart	4
Intestines	2
Jaw	1
Lungs	21
Liver	8
Metacarpal bones	1
Not stated	28
None (?)	83
Neck	2
Occiput	2
Omentum	1
Opposite kidney	3
Pelvic bones	2
Pancreas	1

[1]Chir. klin. der Nierenkrankheiten, Berlin, 1901, p. 502.

Pleura	5
Peritoneum	2
Peribronchial glands	5
Regional lymph glands	11
Ribs	6
Scapula	1
Scar	9
Skin	1
Spleen	3
Tibia	1
Temporal bone	1
Ureter, same side	2
Uterus	1
Vertebrae (dorsal)	5
Vertebrae (lumbar)	2
Vena cava	6

The question of the adrenal origin of these growths will first be taken up. Grawitz[1] gives the following reasons for believing that these growths are of adrenal origin: (1) the position of the growth under the capsule, where, as is well known, aberrant portions of the adrenal substance sometimes called "rests" are frequently found; (2) the characteristic form of the cell, resembling the adrenal cell, which does not in any particular resemble the cells of the normal kidney; (3) the characteristic fatty infiltration of the cells of the tumor, which infiltration is never found in the cells of the urinary tubules, but is a constant feature of the adult adrenal cortical cell; (4) the presence of a limiting capsule which sharply demarcates the growth from the surrounding kidney tissue; (5) the relation of the cells to the stroma of the tumor, which recalls in a marked manner the appearance of the arrangement of the cells in the fascicular portion of the normal adrenal cortex, particularly with reference to the arrangement of the cells in columns and rows; (6) Grawitz also mentions amyloid of the vessels in the growth, and

[1] Virch. Arch., 1883, Vol. 93, p. 58.

comments on the rarity of amyloid degeneration in tumors[1].

Further proof of the adrenal origin of these growths is to be found in the great similarity of this form of renal tumor to tumors of the adrenal gland itself. This is a very marked feature. Likewise it is to be noted that hypernephroma is more apt to extend along the course of the blood vessels rather than through the lymphatic system, as in the case of carcinoma of the kidney. The structure of these growths is typically different from the normal kidney structure. There is no real continuity with the urinary tubules. Finally, the nucleolus stains differently from the nucleus; this is rarely seen in the cells of the renal adenoma. Lubarsch[2] makes mention of the giant cells, and calls attention to the fact that these cells are present in simple hyperplastic growths of the adrenal itself. Croftan[3], in a series of ingenious experiments with an extract obtained from hypernephromatous tissue, found that this extract had the same properties in starch solution as an extract obtained from a suprarenal gland; and he proposed to differentiate by chemical tests hypernephroma from other forms of kidney tumor.

The so-called adrenal "rests" from which these tumors arise are of very frequent occurrence in the normal kidney. These "rests" are usually found in the upper pole of the organ, in the cortex directly beneath the capsule. Other portions of the organ may show these "rests," but the principal seat is in the upper part, the usual site of hypernephroma. The "rests" are often multiple, and usually of very small size. Grawitz[4], in speaking of these "rests," calls attention to the frequency with which they are found, and states that he has found an entire adrenal as an accessory organ in the kidney. Usually they are very small, however, and can be seen with the naked eyes as small yel-

[1] In this special case, the first examined by Grawitz, there was also amyloid degeneration of the arteries of the adrenal, while the renal arteries were entirely free from this change.

[2] Virch. Arch., 1894, Vol. 135, p. 204.

[3] Jour. Am. Med. Ass., 1903, Vol. 40, p. 91.

[4] Arch. f. klin. Chir., 1884, Vol. 30, p. 325.

low spots; their nature can be determined only on microscopic examination. While they are most often immediately subcortical, yet at times they may be within the medullary portion of the kidney. This medullary position is easily understood when one considers the embryology of the adrenal and the kidney. In early fetal life the adrenal surrounds the kidney, and in the process of growth bits of adrenal tissue are cut off and included within the organ. In parts where the clefts of the immature kidney include bits of embryonic adrenal there is a tendency for the outer parts of the clefts to close over and include the adrenal "rests." Imbert[1] found "rests" in different abdominal organs ninety-two times in one hundred autopsies. He found them in all parts of the abdomen, but particularly in the urogenital tract. They were discovered in eight per cent. of the cases in the kidney. Schmorl[2] in 510 autopsies found accessory adrenal "rests" in the liver four times. The great majority of these "rests," whether found in the kidney or in other organs, never undergo malignant changes, and they are for the most part pathologic findings. Imbert attempted to produce a tumor by inserting portions of the suprarenal capsule within the kidney. He experimented on dogs. The animals were killed at the end of a month and a half. The tissue had become engrafted within the kidney. On microscopic examination, it was found that the suprarenal tissue had been invaded by leucocytes, but there was no evidence of new growth. In many instances nothing was found but abundant connective tissue. Another dog, killed three and a half months after having been operated upon, was examined, and it was found that the adrenal tissue had become well engrafted. It was adherent and did not seem to have diminished in size. On examination, the tissue consisted of cells entirely infiltrated with fat. It had no capsule, and appeared to be merged in a fibrous tissue which separated

[1]Ass. Franc. d' Urol., Paris, 1899, 4th Sess., p. 527.
[2]Zeigler Beitr., 1891, Vol. 9, p. 524.

it from the kidney. Imbert concluded from these experiments that there was no evidence of tumor reproduction, but that there was evidence of histologic modification seen in neoplasms.

Hypernephromata are by no means confined to the kidney; they are sometimes seen as primary tumors in other organs. Keen, Pfahler, and Ellis[1] in a collection of 163 cases of hypernephroma found 157 in the kidney, 3 in the adrenal, 2 in the liver, and 1 in the uterus. This uterine hypernephroma is a unique case, and is reported by Eastwood[2]. In this case, that of a woman forty-eight years of age, there was a large encapsulated tumor attached to the uterus. The microscopic examination was most carefully made, and tumors of the uterus resulting from Wolffian remains, mixed congenital tumors of Wilms, etc., were eliminated. The presence of a capsule enclosing the tumor, the peculiar grouping of the cells suggesting the zona glomerulosa of the adrenal, the relation of the cells to the blood vessels, and the fat and pigment content of these cells, all confirmed the diagnosis of hypernephroma.

The discussion concerning the nature of hypernephroma of the kidney has been wide and varied. There is by no means now, as has already been mentioned, any uniformity of opinion as to the histogenesis of the growth and as to the meaning and interpretation of the pathologic findings. It may be well to review in brief the opinions of various observers and to relate the reasons given for these opinions.

Grawitz[3] in commenting upon the minute structure of the growth remarks that it reminds one sometimes of an adenoma, sometimes of a sarcoma, or of a carcinoma. Most of his article is devoted to the proof that the tumor is of adrenal origin. In his first paper,[4] he calls special attention to the

[1] Am. Med., 1902, Vol. 8, p. 1047.
[2] Lancet, 1902, Vol. 1, p. 90; and Tr. Path. Soc., London, 1902, Vol. 53, p. 155.
[3] Arch. f. klin. Chir., 1884, Vol. 30, p. 824.
[4] Virch. Arch., 1883, Vol. 93, p. 41.

great similarity which the growth has to sarcoma. On the whole, he makes no attempt to classify the growth, and is content to call attention to its existence as a new form of tumor hitherto unrecognized.

No further attention was given to this tumor until the publication of de Paoli's[1] article. De Paoli entirely ignored Grawitz's previous work, and, in fact, does not mention his name at all. De Paoli described his tumor, paying special attention to the disposition of cells upon dilated capillaries. He called attention to the arrangement of cells in palisade form upon the blood vessels, and laid special stress upon the fact that between the endothelial wall of the capillaries and the cells there was no interposition of tissue. In some of the capillaries there was proliferation of endothelial cells which projected into the lumen, while some of the endothelial cells appeared to be multinuclear. The capillary vessels anastomosed with each other, and there was hyaline degeneration of these cells arranged along the capillaries, and likewise those of the connective tissue. De Paoli called particular attention to the fact that the blood vessels themselves formed the framework of the tumor, and he believed beyond question that there was proliferation of these endothelial cells, and from the fact of this proliferation[2], the arrangement of the vessels, and finally, the fact that the perithelial cells are looked upon by histologists as connective tissue cells, that a tumor arising from their proliferation should be called an angiosarcoma. He likewise[3] refers to the apparently alveolar arrangement in other parts of the tumor, in the second case that he describes. "There is no alveolar structure, i.e., cell masses, in the interior of the cavities which are formed from connective tissue trabeculae and the vessels; close examination shows even in the center of the cavities a network of delicate connective tissue trabeculae with vessels, or isolated vessels, around which the ap-

[1]Beitr. z. Path. Anat. u. z. Allgm. Path., Jena, 1890, Vol. 8, p. 140
[2]Loc cit., p. 146.
[3]Loc. cit., p. 154.

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parently free cells are arranged." De Paoli is quite sure that even this alveolar arrangement does not militate against his opinion, and he believes that even here there is a perithelial proliferation and true angiosarcoma. He admits, however, that one may be mistaken in believing that he is dealing with the alveoli of a carcinoma, but "one recognizes that the tubular arrangement disappears following the hyaline degeneration of the cells of the cylinders, and atrophy of the connective tissue with obliteration of the capillaries." De Paoli admits the epithelial appearance of the cells in the cylinders of the cavities, but he states that this appearance alone is not sufficient to make the diagnosis of an epithelial tumor, though just why he entertains this opinion is not perfectly apparent.

Beneke[1] described a tumor which he called a growth "originating in adrenal tissue in the kidney." Beneke declared that in his opinion there could be no doubt as to the direct development of sarcoma from adrenal tissue, and he was sure that he found in this growth, which he examined, adrenal tissue in its resting and proliferating condition side by side, and with it true sarcoma. He was positive in the belief that there was a transformation of the tissue, and not merely an invasion of foreign sarcomatous tissue into adrenal elements accidentally present. He believed the alveolar form of the growth to be more certainly of a sarcomatous nature than the palisade form. He did not think that the stroma took part in the sarcomatous growth, although it showed an increase in cells and the formation of interstitial substance. He thus inclined to the belief in a sarcoma. Beneke[2], however, betrayed a certain amount of doubt when he mentioned that, "it is of interest to observe the similarity of the growth with carcinoma, a peculiarity which this tumor shares with every malignant tumor of the parenchymal cells of the adrenal."

[1]Beitr. z. Path. Anat. u. z. Allgm. Path., Jena, Vol. 9, p. 458.
[2]Loc cit., p, 481.

Driessen[1] described a tumor which under the microscope showed a striking similarity to the structure of endothelioma of bone. There were the "same sharply outlined epithelial-like cells of clear glassy appearance, heaped up in the alveoli, while in the peripheral parts of the tumor they were arranged in palisade form around the capillary walls." With this tumor there was no trace of infiltration, and "every lymphatic whose normal endothelial lining was lost, was filled with one or more tumor cells which appeared to have an epithelial character." Driessen considered that the tumor arose from the endothelial cells of lymphatics. He commented particularly on the great similarity of this kidney tumor with the endothelial tumor of bone, as shown by many points, the most important of which was the presence of cavities filled with blood. Driessen also called attention to the "papillary projections formed of a central small blood vessel and cells arranged around it." He admitted[2] that his tumor agreed entirely with the cases described by de Paoli under the name of angiosarcoma of the kidney, and he further admitted[3] that his tumor had "many points in common with the so-called cases of 'struma' of the adrenals, yet there is no ground for considering the two to be of the same origin." In his conclusions he distinctly asserted that endotheliomata being of connective tissue nature, the tumor could not be classified from a pathologic point of view as a carcinoma.

Sudeck[4] rejected entirely the conclusions of those observers who had previously written about this subject, and furthermore denied that the growth had anything whatever to do with adrenal "rests." It was his opinion[5] that they were all adenomata of the kidney. Sudeck ascribed their origin to the epithelium of the uriniferous tubules and he

[1]Beitr. z. Path. u. z. Allgm. Path., Jena, 1892 and 1893, vol. 12, p. 103.
[2]Loc. cit., p. 108.
[3]Loc. cit., p. 110.
[4]Virch. Arch., 1893, Vol. 133, p. 407.
[5]Loc. cit., p. 407.

claimed that he was able to trace the development from the proliferation of the urinary tubules, "which from the beginning showed an atypical character." He called attention[1] to the fact that the tumor was vascular, consisted largely of capillaries, and that "a network of tumor cells is surrounded by capillaries without being separated from the wall of the capillary by connective tissue." He claimed also that a picture of cells arranged in tubules was later produced. He likewise rejected the idea that there was fatty infiltration, and called it a fatty degeneration.

Sudeck's views have not been supported by the observations of other men, and Kelly[2] observes that "there is no ground whatever that there first occurs a proliferation of the epithelium of the uriniferous tubules, and that there subsequently ensues a formation of newly developed blood vessels which penetrate the cells, and about which these cells arrange themselves."

Lubarsch[3] likewise entirely rejected Sudeck's views, and insisted on a suprarenal origin of the growth, stating his reasons therefor, which were practically those of Grawitz and his followers. Lubarsch did not attempt to classify the growth, and was content[4] to call it a "hypernephroid tumor," or, "*still better, a tumor of the type of the adrenal, with or without malignant characteristics.*" Thus, it will be seen that it was Lubarsch, and not Hansemann, as is generally stated, who gave this tumor its present name "hypernephroma." Lubarsch leaves the whole question open whether these tumors should be called adenomata, carcinomata, or angiosarcomata, although he is strongly inclined, from the morphologic standpoint, to regard them as sarcomata.

Birch Hirschfeld[5] in speaking of the growth, says that it is impossible at the present time to classify it. As to the

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[1]Loc. cit., p. 418.
[2]Phil. Med. Jour., 1898, Vol. 2, p. 286.
[3]Virch. Arch., 1894, Vol. 135, p. 190.
[4]Loc. cit., p. 195.
[5]Path. Anat., Spec., Leipsic, 1895, Vol. 2, p. 838.

alveolar arrangement seen in the growth, Birch Hirschfeld quotes Marchand, who calls attention to the fact that the alveoli present remind one of glandular alveoli, since the cells which lie directly on the capillary walls without the formation of a real membrana propria, may take on a more cylindrical form. There is, however, an analogy for this change in the normal adrenal in the horse[1].

Manasse[2] still further complicates the question by introducing new elements. He describes an "angiosarcoma" which he calls a "perivascular sarcoma"; he also describes a "venous endothelioma[3]" and furthermore an "endothelioma arising from lymph spaces."[4] Without going into the details of his description of these tumors, it may be said that all these tumors were very similar in appearance.

Albarran and Imbert[5] add a new element in the discussion of this tumor. They describe a growth whose principal characteristic under the microscope is large cells with clear protoplasm. When "benign," they call the growth an adenoma, but when "malignant" in its clinical course, an epithelioma. Both present the same microscopic appearances. They call this tumor "adenoma" or "epithelioma with clear transparent cells" (*"à cellules claires"*), in consequence of the transparent look which the cells have when the abundant fat which they contain has been dissolved out in the process of mounting. The authors admit that the tumors have a most striking resemblance to hypernephroma both as regards the disposition of the cells in alveoli and also as regards the cellular arrangement in some places in rows along the walls of the capillaries.[6] The authors assert that these tumors may have a double origin, namely, from the renal epithelium, and also from aberrant suprarenal

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[1] See Sudeck-Virchow Archiv., 1893, Vol. 133, p. 420.
[2] Virch. Archiv., 1895, Vol. 142, p. 287.
[3] Loc. cit., p. 302.
[4] Loc. cit., p. 309.
[5] Les Tumeurs du Rein, Paris, 1903, p. 15.
[6] Loc. cit., pp. 26 and 57.

"rests" in the kidney.[1] Inasmuch as these tumors correspond in every way with Grawitz' tumor, it is difficult to see what is to be gained by Albarran and Imbert's subdivision, which seems to rest on insufficient grounds.

Kelly[2], in an excellent article on the subject, reviews the literature, and cites the opinions of various authors. He vigorously combats the theory of Sudeck, as already mentioned; and refers to the histogenesis of the growth, believing that[3] "neither the purely histogenetic nor the purely morphologic basis of classification of tumors is comprehensive and correct, and that both must be employed in conjunction with each other." Kelly[4] believes that the tumor is of relatively common occurrence, and he calls attention to the great difference there is between this form of tumor and the ordinary kidney carcinoma, especially as regards metastases, and he regards it as particularly important that the metastases sometimes reproduce almost completely the structure of the zone fasciculata of the adrenal, whereas, the primary growth may exhibit many different pictures. Kelly is sure, however, that there is no question but that they are of adrenal origin. He comments also on the fact that there is great variability in the histologic structure of the hypernephroid tumors, and as a result there has been much confusion in regard to their exact nature. Kelly believes[5] that "the designation of hypernephroid tumors as 'angiosarcoma' or 'perithelioma,' though justifiable from a purely morphologic standpoint, is directly indicative of the derivation from the suprarenal capsule, for the reason that this organ, especially during the period of its development, forms a physiologic paradigm of such new growths."

It will thus be seen that Kelly is rather inclined to the belief that hypernephroid tumors are angiosarcomata or

[1]Loc. cit., p. 203.
[2]Phil. Med. Jour., 1898. Vol. 2, p. 223.
[3]Loc. cit., p. 225.
[4]Loc. cit., p. 384.
[5]Loc. cit., p. 286.

peritheliomata, purely from a morphologic standpoint, and nothing else, for he considers that a morphologic basis is not sufficient to classify this tumor, nor indeed is the histogenetic.

Kelynack[1] discusses adrenal growths in the kidney, and declines even to venture an opinion as to whether a certain tumor arises from inclusions of adrenal tissue, but thinks that in time further and more certain indications will be apparent than is the case at present. He does, however, give an exact description of the microscopic characters of these growths, and is rather inclined to the belief that they are of adenomatous formation. "The whole question of adenomatous growths met with at all periods of life requires a most thorough investigation; but until whole specimens of a renal growth are submitted to thorough microscopic investigation, our knowledge of this important and probably very complex adenomatous growth will not advance far. In the mere naked eye characters the adenomatous formation of growth often resembles the sarcomata."

Busse[2] is entirely in accord with Grawitz in his belief concerning adrenal inclusions, and their subsequent development as tumors. He was confirmed in this belief by a study of the embryonic adrenal and he repeatedly found[3] structures in the embryonic adrenal resembling those in the tumor. "The chief trouble in the interpretation of the microscopic pictures arises from the papillary, glandular, or cystic formation."

Burkhardt[4] has no doubt as to the origin of these malignant growths from the adrenal substance, and gives four cases. Burkhardt says: "The transition of the proliferated epithelioid forms of the endothelioma into that of the actual cells of the tumor was everywhere so diffuse, and the similarity of both kinds of cells was so great that differentiation

[1]Renal Growths, London, 1898, p. 146.
[2]Virch. Arch., 1899, Vol. 157, p. 393.
[3]Loc. cit., p. 395.
[4]Dtsch. Zeit. f. Chir., 1900, Vol. 55, p. 91.

was impossible. Probably such pictures as these have confused the suprarenal origin of these tumors, and they have been taken for endotheliomata." Burkhardt[1] is of the opinion that "malignant tumors of the adrenal in the kidney develop from a pure adenomatous growth of adrenal tissue, but not directly from misplaced adrenal elements." In his specimens "it was plainly seen how the strumous tissue was transformed into a solid, cellular, papillary, and alveolar, or irregularly diffuse growth, in places corresponding to the relations that are found in the malignant adenomata. This irregular many-layered alveolar structure was continued into a diffuse cell growth, or it formed larger alveolar cell complexes." The author, however, is not sure as to the exact histogenesis of this growth, and admits[2] that the question had better be left undecided for the present at least. The decision, according to Burkhardt, depends on two points: "first, according to what principle tumors in general should be classified, and secondly, what position the adrenal holds both in embryologic and physiologic relations." He is inclined to think that a purely morphologic classification is insufficient, and also that there is great objection to the histogenetic classification. The histogenetic principle of classification cannot be considered without flaw, because the grounds of this method are variable, and histogenetic classification cannot be carried out completely, because in many cases it would be necessary to go back to the original development, and not in the exact way in which the tissue has been differentiated during development. Burkhardt, therefore, is inclined to believe that it is best to look upon these adrenal tumors in the kidney in the same way as malignant tumors of other glandular organs, which are accustomed to be designated as carcinomata. "Tumors of the adrenal show peculiarities which are never found except in carcinomata, namely, solid cell nests, and papillary outgrowths of cells.

[1]Loc. cit., p. 112.
[2]Loc. cit., p. 116.

Only the diffuse cell growth so often seen and the alveolar structure correspond more to sarcoma. But even in the first case it is often observed that two or three cells lie close together without intercellular substance. We also see in medullary carcinoma single epithelial cells lying isolated in the stroma. As in carcinoma of other organs we can recognize here three forms: the *destructive adenoma, carcinoma simplex, and medullary carcinoma.* In the malignant adenoma of the adrenal we usually find all three forms united in the same tumor, so that the transition from one form to the other appears more or less obscure. *It is this peculiarity which causes the great variation and irregularity in the structure of the tumor.* From these considerations it is necessary to consider the new growths of the adrenal like those of other glandular organs, and as long as we call the malignant tumors of the latter, carcinomata, it seems necessary also, for the sake of similarity, to make no exception in the former case, and to rescue these tumors from the nomadic life which they have hitherto led. To give them alone a special place is not justifiable."

Hektoen and Reismann[1] in commenting on these tumors, refer to the Cohnheim theory of tumor formation. They admit the impossibility of classifying the growth either with the carcinomata or sarcomata. Morphologically they sometimes deserve the name of one, sometimes that of the other; histogenetically, the "position would rest with the nature of the cells of the adrenal gland." The authors decline to express an opinion.

Borst[2] gives an excellent description of the growth, and describes the minute anatomy with great completeness. He refers to the alveolar carcinoma-like structure, and to the difficulty of separating this class of growth from some growths of the kidney. He also cautions against mistaking these suprarenal growths for certain kidney tumors

[1] Am. Text Book of Path., Phil., 1901, p. 983.
[2] Der Lehre von dem Geschwülsten, Wiesbaden, 1902, p. 791.

which belong to the endotheliomata or peritheliomata (angiosarcoma, perivascular sarcoma), and observes that many authors consider these angiosarcomata and peritheliomata as of suprarenal origin. Borst admits that a large list of kidney tumors may be considered to be derived from transplanted suprarenal tissue.

Hansemann,[1] in speaking of these tumors, admits that they arise from adrenal "rests," and that they are malignant tumors from the very beginning. He is unwilling to classify the growth, and says that it is better to put the whole question aside. He states that the true kidney adenomata are different from hypernephromata in their typical glandular structure; while papillomata are characterized by the fact that they have a papillary structure throughout, which is the case only in isolated parts of the hypernephroma, and never in the latter reaches a typical formation. Hansemann,[2] however, following Driessen, speaks of another form of kidney growth, the "endothelial adenoma," and[3] goes on to say that these tumors may easily be confused with hypernephroma, for in many places there is "a certain similarity in structure. Both have fatty content in their cells, and a large amount of blood, but while in hypernephroma the blood occurs in spaces due to degeneration, in the endothelial adenoma, on the other hand, it occurs in spaces originally cavernous, where the regressive change is the slightest; both tumors have, as a rule, a capsule."

It is thus evident that Hansemann leans towards the endothelial nature of this growth. Hansemann is inclined to believe[4] that the position of the growth in the interior of the kidney makes it impossible that it should be hypernephroma, but we have seen that other authors believe that this does not hold. Hansemann would not trust himself to

[1]Zeit. f. klin. Med., 1902, Vol. 44, p. 7.
[2]Loc. cit., p. 11.
[3]Loc. cit., p. 12.
[4]Loc. cit., p. 12.

make a diagnosis on microscopic appearances. It is evident, therefore, that he is somewhat in doubt.

A perusal of these views shows immediately how confusing is the whole question of classification of these tumors. The arguments for and against are ingenious and interesting. So far no uniformity of opinion has been reached, and those who are in doubt about the question are in greater numbers than those who have ventured to definitely and positively classify the growth.

Those who prefer to call the tumor an endothelioma believe in the proliferation of the endothelial cells of the blood vessels and lymphatics. Among these are Manasse and Driessen. The latter especially is sure that the lymphatics are largely interested in the production of this growth, and he thinks that the tumor is the result of proliferation of the endothelial cells of the lymphatics. Manasse is likewise a strong supporter of this view, but he shows the uncertain state of his mind in regard to them, when he subdivides them into three classes: the endothelioma of lymphatics, the endothelioma of veins, and the angiosarcoma.

Carcinoma is suggested by the alveolar formation, and were this the only typical appearance of the growth, there would be good reason for maintaining this exclusive view in regard to the growth. The epithelial-like cells of which the growth is composed is strong evidence that the growth is of a carcinomatous nature; but the mixed character of the histologic structure in the same tumor militates largely against this view. Burkhardt tried to overcome the difficulty by suggesting the names "malignant adenoma," "carcinoma simplex," and "medullary carcinoma" for the growth, but this subdivision merely creates more confusion.

Those who call the growth adenoma have much to fall back upon. The arrangement of the cells in rows and double rows with an intervening space suggests strongly, on superficial examination, adenoma formation, but the capillary

network and the intimate association of tumor cells with the capillaries is decidedly against this view. Sudeck was the first to insist that adenoma was the correct interpretation, but his views have been, as we have seen, largely discountenanced by the majority of observers. The frequent isolation of the cells, and in many cases their grouping in small masses or chains, hardly recalls the typical adenoma.

Those who hold the view that the tumor is a sarcoma are quite numerous. Manasse, Ulrich, de Paoli, Busse, Beneke, Lubarsch, and Bland-Sutton, were all more or less inclined to the belief that the tumor was a sarcoma. Bland-Sutton[1] is not sure that these tumors are of adrenal origin, and, without committing himself positively, inclines to the belief of a carcinomatous nature. The strongest proof of sarcoma is the disposition of the cells around vascular tufts, the angiosarcoma, which is seen in the more typical form in other parts of the body. DePaoli was sure that he could trace the blood vessels into the alveoli themselves. The alveolar arrangement is explained by some authors as a type of alveolar sarcoma.

In discussing tumor classification, we must bear in mind the histogenetic and the morphologic criteria. The type of cell found in this growth is unquestionably epithelial and this at first sight would seem to militate against the theory of a sarcomatous nature. But if we examine into the embryology of the adrenal the latest views are to the effect that the adrenal is developed from mesenchymal cells. This was Minot's[2] and Poll's[3] view, and no other more satisfactory has been given. Histogenetically, therefore, these adrenal cells are capable of giving rise to a connective tissue growth, a sarcoma. If we adopt histogenetic criteria alone, then the growth is a sarcoma. Morphologically, however, it

[1]Tumors, Innocent and Malignant, London, 1907, p. 111.
[2]Human Embryology, New York, 1892, p. 485.
[3]Hertwig-Handbuch der Vergl. und Exper. Entwickelungslehre der Wirbeltiere, Jena, p. 456.
For the latest views concerning the embryology of the adrenal the reader is referred to Poll's classic monograph.

resembles an adenoma, or a carcinoma. It is obvious that it is impossible to definitely decide in regard to the nature of the growth. It is evident, consequently, that until some definite agreement shall have been decided upon in regard to tumor classification, we cannot do better than to relegate these growths to a class by themselves. The fact that they develop from adrenal "rests" in the kidney is now so commonly admitted that there are few who deny this. It seems to be an incontrovertible fact. The best name for the growth, therefore, one which suggests their pathogenesis, is that first proposed by Lubarsch, hypernephroma.

Symptomatology

Hypernephroma has a slower course, as a general rule, than is usually the case with malignant disease elsewhere in the body. The tumor is frequently discovered by accident, either by the patient or by the physician who chances to make a thorough examination. Possibly the long duration may be due in part to the fact that the tumor often remains localized and is for a long time prevented from spreading by the resisting kidney capsule. If the chief cardinal symptom, hematuria, is absent, a small tumor may remain undiscovered for many months or even years without giving any other indication of its presence than occasional slight pain in the lumbar or hypochondriac region of the affected side. Perhaps, also, the hypertrophy of the sound kidney has something to do with the long duration of the disease; for, as a result of this hypertrophy, the sound kidney takes upon itself the function of the two organs together, and the general health does not suffer in consequence of the inefficient action of an important organ of the body. Hypertrophy, however, sometimes fails to occur in consequence of a nephritis, and in these cases the duration of the disease is much shorter. Other causes, such as poor physique and unusually severe symptoms, may contribute to an unusually severe course and in these cases there may be a rapid end-

ing. Sooner or later, in all cases, the health becomes undermined, the strength fails, and emaciation and cachexia appear.

The smallest tumors usually give rise to no symptoms at all, and in some of these instances the growth may remain of a small size for a number of years. Such growths are frequently found as autopsy findings. They may even attain to a considerable size, as much as several centimeters in diameter, and yet cause no symptoms. In such cases the growth is to all intents and purposes perfectly benign, for it has no effect on the bodily health, and the individual is unconscious of its presence. It is potentially malignant, however, and will, if the individual survives, in time take on active growth and give rise to the usual train of symptoms of malignant disease.

Hypernephroma presents at once three distinct cardinal symptoms, which are hematuria, pain, and tumor. With all these symptoms present, especially when the hematuria is excessive and the tumor large, one instinctively turns to the diagnosis of malignant disease, particularly in a patient in middle life.

In the beginning of the disease the general symptoms are not pronounced. A case is occasionally met with in which anorexia is the only symptom noted. The patient has a distaste for food, especially for meat, without discoverable cause. The appetite, however, is usually preserved, and the general health remains excellent for a long time.

The cause of death in hypernephroma of the kidney is usually cachexia with its attendant prostration. There is a gradual decline in health and strength, progressive emaciation, and if hematuria is abundant, the loss of blood will make itself felt and will hasten the end. The growth occasionally extends along the veins to the heart, and may cause sudden death in this way. Among the rarer causes of death are ulceration of the bowels, occlusion of the bowels, erosion and ulceration of the vertebrae with compression of the

spinal cord resulting in paraplegia, and bursting of the growth into the peritoneum.

Although pain, hematuria, and tumor are the three cardinal symptoms of hypernephroma of the kidney, yet they all are by no means always present in the same case. The disease may be ushered in by any one of these symptoms and the others may appear later.

Pain is due to pressure on a single nerve, or to involvement of the lumbar or even the sacral nerves by extension of the growth. In some instances it may be due to vascular engorgement of the kidney, which exercises compression of the kidney substance, the rigid capsule preventing expansion of the organ as a whole.

In some cases the pain has the characteristics of nephritic colic, and then one may suspect the passage of a blood clot or of a shred of tissue through the ureter. Another cause of pain is distension of the pelvis of the kidney in consequence of blocking of the ureter by an organized clot, or by a portion of the malignant growth. True hydronephrosis, however, but rarely occurs. When it is remarked that pains are felt not only before, but during, an attack of hematuria, one may suspect expulsion of the ureteral clot. The seat of the pain is usually the lumbar region on the affected side, and from here it may extend to the thorax. Radiation to the abdomen, testis, buttock, or thigh is not uncommon. If pain is felt in regions other than the kidney, the usual signs of malignant disease being present in the latter organ, one must think of localized malignant growth in the organ in question.

The intensity of the pain is variable; ordinarily it is moderate in severity, but it may be very severe, and may even cause death from the intense suffering which it occasions. It has no relation with movement, and may come on during the night as well as during the day; this feature serves to distinguish it from pain due to renal calculus, in which disease the pain is more severe on motion. It may

be a dull ache, distinctly localized in the region of the kidney, or it may take the form of simply a feeling of weight in the lumbar region. It is prone to exacerbation, and there are fairly long periods during which no pain at all is felt. A neuralgic character would suggest pressure on the nerves, while an intermittent character is always more characteristic of distension of the renal pelvis. Pressure over the kidney is not apt to increase the pain, but sometimes the patient is unable to lie on the affected side.

It is impossible to say how often pain is a first symptom of the disease, because the published reports are lacking in completeness as to this point. In only thirty-six out of one hundred and seventy-six cases reviewed by the writer was it positively stated that pain was the first symptom of the disease. Doubtless there were actually many more. Pain is mentioned as having been present at some time during the disease ninety-one times; fifty-nine times there was no mention of the symptom, and twenty-six times it was distinctly stated that there had never been any pain at all. In most of the last class of cases, however, the disease had not existed more than a few months at the time the report was written. In one case (No. 83) only, in which no pain had ever been experienced, the disease was known to have existed for a period of five years.

Occasionally the pain does not appear until late in the course of the disease. Cases 27, 36, 76, 120, 134, and 152 are illustrations.

Hematuria is perhaps the most important and the most characteristic symptom of this growth. Its occurrence excites immediate alarm, and directs the attention of the patient to the urinary organs, which had previously been supposed to be in a normal state of health.

The cause of the bleeding in the early stages is probably an intense congestion of the renal parenchyma, but later in the course of the disease erosion of the blood vessels, especially in the renal pelvis, and more particularly of the cali-

ces, gives rise to the copious hemorrhages sometimes seen. The bleeding sometimes takes place directly into the renal tubules at a point unprotected by the capsule of the growth. This is well illustrated by a case reported by Peuckert[1], that of a patient with a small tumor 4 cm. in diameter situated under the kidney capsule. It had given rise to extensive hemorrhages. On examination of the tumor, after removal, it was found that at one point the tumor capsule was wanting and that here the tumor cells appeared to penetrate directly into the kidney parenchyma. The resisting tumor capsule often forms a barrier to the escape of blood, and in some cases the tumor may reach a very large size without there ever having been any hemorrhage whatever. The writer has seen a case of this kind in which there was a large kidney growth, and Taylor[2] records a similar case in a patient who never had had hematuria, from whom a large hypernephroma weighing 6 1-2 pounds was removed.

The hemorrhage comes on insidiously and without warning in most of the cases. The patient may have a sudden desire to urinate, and may notice that the stream is blood red in color. Occasionally the attack is ushered in by a feeling of weight or by a dull pain in the lumbar region; at other times there may be severe renal colic at the time of the expulsion of the blood. Frequently, however, the bleeding is entirely painless. The striking peculiarity is that bodily motion seems to have but little influence in starting up the bleeding. An attack of hematuria is liable to come on at night as frequently as it does in the daytime, and running, or walking, or exercise do not seem to have very much influence in bringing it on. This peculiarity is in marked contrast with the hematuria of calculus of the kidney, in which affection exercise and violent motion of any kind have a decided influence in starting up the bleeding. Occasionally, however, the hemorrhage in hypernephroma ap-

[1]Am. Jour. Urol., 1905, Vol. 2, p. 119.
[2]Am. Jour. Med. Sci., 1903, Vol. 131, p. 210.

pears for the first time after straining at stool or after violent exercise, and even after palpation of a tumor in the lumbar region.

Symptoms on the part of the bladder at the time of the hemorrhage are usually not marked, unless there are clots in the bladder or ureter. Severe colicky pains resembling in every respect the pains produced by the passage of a stone are the result of blocking of the ureter; at the same time there may be pain extending down to the bladder and to the testicle on the affected side and sometimes to the corona glandis. The amount of urine is usually diminished during these attacks, sometimes for days. If there are blood clots in the bladder the usual symptoms of vesical irritability, shown by increased frequency of micturiton, and severe vesical spasm and tenesmus, are present. After the hemorrhage is over there is complete cessation of pain and vesical irritability if all clots have been passed. The alternation of hemorrhage and vesical irritability with periods of absence of hemorrhage and a constant ache in the lumbar region are significant of the disease and are in contrast to the different picture that renal calculus usually presents.

The duration of the hematuria is variable. Some patients do not pass blood more than a few times during the whole course of the disease; others may have an attack of hematuria lasting a few months only and the bleeding does not return until towards the end of the trouble. McCosh[1] reports a case in which there was a very severe attack of hematuria in the very beginning of the disease, seven years previously; there was no bleeding after this until just before nephrectomy was performed. Israel[2] reports a similar case in a patient fifty-six years of age who had had a severe attack of renal colic with hematuria ten years previously; in this case likewise there was entire cessation of the bleeding until just a few months before the operation.

[1]F. T. Brown—Ann. Surg., 1904, Vol 39, p. 300
[2]Chir. klin. der Nierenkrankheiten, Berlin, 1901, p. 511.

Usually an attack of hematuria comes on every few weeks or months in a well marked case of the disease. It lasts a few hours, a few days, or a week or two. Towards the end of the disease it becomes more persistent, and at the end it may be a pronounced symptom. Hematuria of itself is rarely the cause of death.

The sudden alternation of a perfectly clear urine with a severe attack of hematuria is of diagnostic importance. This may happen three or four times in the same day. In such cases the explanation must be sought in the temporary blocking of the ureter by a clot. If this occurs there is apt to be a severe colic.

The amount of blood lost is very variable; at times it amounts to only enough to color the urine red, while at other times the amount of blood passed may be so large as to simulate a true unmixed hemorrhage. The latter cases are rare, and as rule the amount of blood lost at one time is only moderate. Blood casts of the ureter are not uncommon. Large clots of variable sizes and shapes are also seen, and in these cases clotting takes place in the bladder; when these clots are seen the hemorrhage is usually copious and consists of almost pure blood. It is astonishing to see how well a patient stands the loss of blood, even when the hemorrhage has been going on for a number of days or weeks. Anemia is not marked as a rule if the patient has time to make up the loss of blood during the intervals between the attacks; but if there has been a continuous copious hemorrhage the anemia may be of a severe type.

Keen, Pfahler, and Ellis[1] in a series of twenty-six cases found hematuria as a symptom in nineteen. The hematuria was associated with pain in fourteen, and with tumor in fifteen of the cases.

Albrecht[2] in a series of twenty-eight personal cases found hematuria in eleven of them, or 39.3 per cent. As a

[1] Am. Med., 1904, Vol. 8, p. 1043.
[2] Verh. f. Dtsch. Ges. f. Chir, 1905, Vol. 34, p. 620.

first symptom Albrecht noted hematuria in six of these twenty-eight cases.

In the list of 176 cases compiled by the writer there were eighty-nine cases, or 50.5 per cent., in which hematuria was a prominent symptom at some time during the disease. There were sixty-one cases, or 34.6 per cent, in which it was distinctly stated that there had never been hematuria up to the time the report was written. This is a large proportion of negative cases, when one considers the vascular nature of these tumors, and it is proof that the capsule of the tumor prevents the escape of blood, otherwise there must have been more positive cases.

In some of these negative cases, referred to above, the disease was known to have existed for a considerable length of time. The following table shows the most marked examples:

TABLE SHOWING DURATION OF DISEASE IN WHICH THERE WAS NO HEMATURIA.

Cases.	*Duration of disease.*
No. 4	5 years
" 11	15 "
" 18	2 "
" 21	several "
" 33	2 "
" 34	6 "
" 68	3 "
" 72	2 "
" 90	2 "
" 111	6 "
" 116	2 "
" 120	3 "
" 129	5 "
" 154	2 "
" 155	2½ "

Peukert[1] gives as high as 80 per cent. of all the cases as starting with hematuria. This seems a high percentage and the writer has been able to find records of only sixty-three

[1]Am. Jour. of Urol., 1905, Vol. 2, p. 76.

cases in which it was stated that hematuria was the first symptom of the disease. This number represents 70 per cent. of the cases in which hematuria was stated to have been a symptom. There were doubtless actually more cases but incomplete records do not permit of their being added.

Hematuria as a sole symptom sometimes occurs. This is particularly so in the early part of the disease before the tumor has had time to grow. These are cases which give most trouble in diagnosis, for it is very difficult to make a differential diagnosis here short of exploratory incision. Cases 103, 146, 147, and 148 are illustrative.

Occasionally hematuria appears late in the course of the disease, which has perhaps been suspected to have existed for several years. Cases 19, 31, 36, 57, 133, 148, 152, and 172 are all remarkable in this respect.

The hemorrhage may extend over a number of years in a protracted case. In these instances the rate of growth is slow and the general health suffers but little. Israel[1] reports a case in which the disease was suspected to have existed twelve years, and during all that time there had been attacks of hematuria. In another of Israel's[2] cases the hematuria extended over a period of ten years, and Mayo[3] has reported a similar case in which the hematuria was known to have been present for a period of ten years.

In most of Albrecht's[4] cases the period of intermittent hematuria was not longer than a year before the appearance of the tumor. In one of his cases it was three years, and in another, six years. In one of Hildebrand's[5] cases the hematuria had existed for a period of eight years before the appearance of the tumor.

The tumor may be so small as to escape notice, especially when situated in the upper pole of the kidney, its usual seat,

[1]Chir. klin. der Nierenkrankheiten, Berlin, 1901, p. 508.
[2]Loc., cit., p. 511.
[3]Herb.—Am. Jour. Med. Sci., 1905, Vol. 129, p. 1011.
[4]Verh. d. Dtsch. Ges. f. Chir., 1905, Vol. 34, p. 620.
[5]Arch, f. klin. Chir., 1894, Vol. 47, p. 226.

and if it is well within the renal parenchyma. It may, however, be of large size, even equalling the size of the adult head.

The growth generally preserves the characteristic shape of the kidney, and this serves, in a measure, to distinguish it from splenic enlargement, if the growth is on the left side. The surface of the mass, however, is often irregular and nodular. A cystic formation in the interior is especially apt to give it an irregular outline. The usual seat of the tumor is in the lumbar region, and it extends forward toward the abdominal cavity, the direction of least resistance. It generally lies between the ribs and the iliac crest, and there is no space between it and the mass of spinal muscles. A small renal tumor is capable of slight movement, but a large one with adhesions is firmly fixed. Pulsation has been noted in the tumor, and also bruit, both being synchronous with the heart beat. These signs are important with reference to differential diagnosis in those rare cases of aneurism of the renal artery.

Tumor is present in the great majority of the cases of hypernephroma, and it is sure to be noticed when large enough. Usually it is the patient who finds it. Its usual seat in the upper pole of the kidney is an unfortunate circumstance because this situation is unfavorable for early detection, the ribs forming a covering which protects it and does not permit of the tumor being felt; the growth may thus escape observation for a long time, and this circumstance unfortunately may give opportunity for the spread of the disease by metastasis. In these cases the early occurrence of hematuria is a fortunate circumstance, and should blood appear in the urine a careful and thorough exploration should immediately be done so that the seat and cause of the bleeding may be positively determined. There should be no hesitation about an exploratory nephrotomy in these obscure cases of renal hematuria.

In the writer's list of cases the presence of tumor is men-

tioned 143 times; seventeen times it was absent, and sixteen times no mention was made of its presence.

Albrecht[1] found tumor in twenty-six of his twenty-seven cases. In only one case in this series was the tumor the first symptom of the disease.

Keen, Pfahler, and Ellis[2] noted tumor twenty-one times in twenty-six cases. The tumor was movable in twelve of these cases.

It is difficult to give exact figures as to the comparative frequency of tumor and hematuria as a first symtom, because the reports of cases are incomplete in this respect. In ten cases (Nos. 6, 10, 27, 36, 83, 87, 117, 140, 145, and 172) the hematuria antedated the appearance of the tumor; in fourteen cases (Nos. 68, 71, 72, 77, 80, 85, 89, 91, 120, 134, 150, 154, 167, and 169) the tumor antedated the hematuria; and in eleven cases (Nos. 9, 28, 57, 60, 81, 96, 100, 101, 143, 149, and 173) the tumor and the hematuria appeared simultaneously. When one considers that in only a little more than half the cases does hematuria appear at all, it is not surprising that there are not more reported cases in which hematuria antedates the tumor. The following table shows at a glance the duration of the disease, of the hematuria, and of the tumor:

TABLE SHOWING THE DURATION OF THE DISEASE, THE DURATION OF HEMATURIA, AND THE DURATION OF THE TUMOR

Case.	Duration of Disease.	Duration of Hematuria	Duration of Tumor
No. 6	2 yrs.	2 yrs.	8 mos.
" 9	5 mos.	5 mos.	5 "
" 10	3 yrs.	3 yrs.	2 yrs.
" 11	15 "	0	1½ yrs.
" 27	6 "	6 yrs.	1 yr.
" 28	6 mos.	6 mos.	6 mos.
" 33	2 yrs.	0	2 yrs.

[1]Verh. d. Dtsch. Ges. f. Chir., Berlin, 1905, Vol. 34, p. 630.
[2]Am. Med., 1904, Vol. 8, p. 1043.

Case.	Duration of Disease.	Duration of Hematuria	Duration of Tumor
No. 36	3 yrs.	6 mos.	4 mos.
" 37	9 mos.	?	9 "
" 47	5 yrs	?	5 yrs.
" 48	6 mos.	?	6 mos:
" 57	2 yrs.	4 mos.	4 "
" 60	1 yr.	1 yr.	1 yr.
" 61	3 mos.	0	3 mos.
" 67	4 "	?	4 "
" 68	3 yrs.	0	3 yrs.
" 71	2 mos.	0	2 mos.
" 72	2 yrs.	0	2 yrs.
" 74	6 mos.	?	6 mos.
" 76	6 yrs.	?	6 yrs.
" 77	5 mos.	0	5 mos.
" 79	8 "	?	8 "
" 80	6 "	0	6 "
" 81	2 yrs.	2 yrs.	2 yrs.
" 83	5 "	5 "	2 "
" 84	2 "	?	2 "
" 85	6 mos.	0	6 mos.
" 87	8 yrs.	8 yrs.	few days
" 89	6 mos.	0	6 mos.
" 91	6 "	0	6 "
" 96	1 yr.	1 yr.	1 yr.
" 100	8 mos.	8 mos.	8 mos.
" 101	4 "	4 "	4 "
" 107	3 yrs.	3 yrs.	3 yrs.
" 120	3 "	0	3 "
" 132	7 mos.	?	7 mos.
" 134	2 yrs.	0	2 yrs.
" 140	4 "	5 yrs.	6 mos.
" 143	5 "	5 "	5 yrs.
" 145	6 mos.	3 mos.	6 weeks
" 149	few months	few months	few months
" 150	1 yr.	0	2 yrs.
" 154	2 yrs.	0	2 "
" 167	3 "	?	3 "
" 169	2 mos.	0	2 mos.
" 172	8 yrs.	3 yrs.	1 week
" 173	5 mos.	5 mos.	5 mos.

There is some evidence that hypernephroma of the kidney may occasion increased arterial tension. Eisendrath[1]

[1]Jour. Am. Med. Ass., 1900, Vol. 34, p. 649.

brought out this point and related four cases in which there was increased arterial tension. Two of these cases he saw in his practice and in both of them death was caused by cerebral hemorrhage; the other two cases were reported by Neisser and Holmes. Keen, Pfahler, and Ellis[1] also speak about arterial tension. They think that the symptom implies increased secretion of adrenal tissue. Ochsner[2] likewise mentions this condition and believes that tumors of this type cause severe systemic disturbances, notably those due to arterial pressure. He asserts that patients frequently die from hemorrhage of the brain or other important structure.

The writer has found but few references on this point but he believes that death from rupture of the arteries must be very rare, for it has been but seldom mentioned. Eisendrath is of the same opinion, and this author speaks of twenty-nine cases in which no mention is made of an increased arterial pressure. It is probable, therefore, that this accident seldom occurs.

Symptoms on the part of the stomach are rare, and when they occur, they suggest metastasis. The disease has occasionally been known to have been ushered in by gastric symptoms alone. Nausea, vomiting, distaste for food, and symptoms of indigestion are complained of, and if the growth has attacked the stomach the characteristic vomitus will make its appearance. If the symptoms are entirely reflex, the usual train of symptoms seen in gastric disturbance of nervous origin are manifested.

Dyspnea is also an occasional symptom, and so is fever of the hectic type. Ascites and varices when present are due to occlusion of a large venous trunk by the growth, and edema of the lower extremities when it occurs has a similar origin. Jaundice has been noted in a certain number of cases, and here the jaundice is due either to extension of the

[1]Am. Med., 1904, Vol. 8, p. 1050.
[2]Jour. Am. Med. Ass., 1900, Vol. 34, p. 649.

disease to the liver, or else to obstruction of the lumen of the common duct in consequence of compression.

The occurrence of varicocele was first noted by Guyon[1], who remarked that varicocele occasionally accompanied renal tumor. He also noticed that it was usually unaccompanied by pain in the testicle and that hydrocele was absent. There is some difference of opinion as to the cause of the symptom. It may be present when there is enlargement of the ganglia around the hilus of the kidney, and then it is thought to be due to pressure upon the spermatic vein; but cases are not uncommon in which no such ganglia have been found; and again, ganglia may be present without the occurrence of varicocele. Another explanation is the presence of a secondary thrombus in the renal vein, which extends to the vena cava, or else an extension of the growth itself into these veins. Legueu[2] has made a study of this symptom, and he found that varicocele had no relation to the size of the tumor.

The presence of varicocele, especially when it occurs on the right side, the unusual side in cases of ordinary varicocele, is extremely suggestive of renal growth, and should always lead to an examination of the lumbar region. In examining for this symptom the patient should be in the erect posture, for if the patient is lying down the veins are not so likely to be distended, and slight degrees of engorgement may escape detection.

The duration of the disease is variable. The great difficulty in estimating the duration arises from the fact that in the beginning it is almost always insidious and unrecognized. A tumor may be present in the kidney region for a period of many years and during this time may give rise to few, if any, symptoms. In Beneke's[3] case, the duration was six years, and the termination was by ascites with its attendant

[1]Leçons Cliniques, sur les Maladies des Voies Urinaires, Paris, 1881, p. 317.
[2]Ass. Franç. d'Urol., 2d Sess., 1897, p. 180.
[3]Zeigler Beitr., 1890, Vol. 9, p. 440.

symptoms; in Grawitz's[1] case the disease lasted five years and death was caused by peritonitis; in Bell's[2] the duration was five years. In none of these cases was operation performed.

The following table, taken from the list on pages 84-108 shows the duration of the disease before nephrectomy was performed:

Cases.		*Duration of the Disease.*
No.	10	3 years
"	11	15 years
"	22	6 years
"	27	6 years
"	29 (age 54—pain since boyhood)	
"	32	5 years
"	47	5 years
"	53	7 years
"	62	10 years
"	66	4 years
"	68	3 years
"	76	6 years
"	87	8 years
"	97	5 years
"	106	12 years
"	108	10 years
"	111	6 years
"	114	5 years
"	117	3 years
"	120	3 years
"	133	5 years
"	136	4 years
"	140	5 years
"	143	5 years
"	148	7 years
"	152	6 years
"	167	3 years
"	172	8 years

[1]Virch. Arch., 1883, Vol. 93, p. 50.
[2]Canada Lancet, 1904-5, Vol. 38, p. 900.

Keen, Pfahler, and Ellis[1] give the duration of the disease at from fifteen weeks to eight years, with an average of two years and three months. Richards[2], in a list of forty cases, in which there were twenty-five males and fifteen females, found an average duration of two and a half years.

In 89 cases in the writer's list of 176, in which the duration of the disease was stated, the symptoms had existed two years or less when nephrectomy was done; and in 53 of these 89 cases the duration of symptoms was not over a few months, when nephrectomy was required.

In 32 cases of this series the duration of the disease, from beginning to end, was stated, the nephrectomy intervening. The average duration in these 32 cases was 3 1-2 years. These cases are tabulated as follows:

DURATION OF THE DISEASE FROM BEGINNING TO END.

Case.		*Duration.*
No.	2	7 yrs. 2 mos.
"	3	2 yrs. 5 mos.
"	5	11 mos.
"	6	3 yrs. 8 mos.
"	8	1 yr. 4 mos.
"	9	10 mos.
"	10	3 yrs. 3 mos.
"	13	1 yr. 3 mos.
"	22	10 yrs. 3 mos.
"	28	3 yrs.
"	32	5 yrs. 4 mos.
"	55	1 yr.
"	57	2 yrs. 6 mos.
"	63	1 yr.
"	70	2 yrs. 2 mos.
"	73	10 yrs.
"	85	1 yr.
"	97	7 yrs. 3 mos.
"	98	1 yr. 9 mos.
"	101	1 yr. 10 mos.
"	103	2 yrs.

[1]Am. Med., 1904, Vol. 8, p. 1043.
[2]Guy's Hosp. Rep., 1905, Vol. 59, p. 245.

No.	111	8 yrs.
"	114	5 yrs.
"	119	2 yrs. 3 mos.
"	122	6 mos.
"	140	5 yrs. 2 mos.
"	143	5 yrs. 3 mos.
"	144	2 yrs.
"	145	4 yrs. 3 mos.
"	148	7 yrs. 2 mos.
"	166	1 yr. 8 mos.
"	174	1 yr. 6 mos.

The duration of the disease is generally very much shortened by the early appearance of metastases, and in many instances among the recorded histories this is brought out in a striking manner. When the metastases are of large size and when they give rise to severe pain and other exhausting symptoms, they may completely overshadow the renal affection, especially if symptoms on the part of the kidney have been obscure. A diagnosis of hypernephroma of the kidney has often been made, not from renal symptoms, but from an examination under the microscope of a bone tumor which has been removed by operation, and which has showed the characteristic structure peculiar to these growths.

The following table gives cases in which there were serious metastases and in which no kidney operation was performed. It is to be particularly noted that the duration of the disease in most of the cases was not over a few months. Death occurred in all.

TABLE SHOWING DURATION OF THE DISEASE IN WHICH THERE WERE EXTENSIVE METASTASES.

Case.	*Duration.*	*Metastases.*
No. 4	5 yrs.	Slight kidney symptoms. Metastases in both femurs, humerus, occiput, etc.
" 7	1 yr.	No kidney symptoms. Metastasis in right frontal bone.

No. 15	6 mos.	Slight kidney symptoms. Metastases in knee (amputation) and finger.
" 16	10 mos.	No kidney operation. Metastasis in shoulder.
" 37	9 mos.	No kidney operation. Metastases in liver, lungs, and intestines.
" 39	1 yr.	No kidney operation. Metastases in liver and lungs.
" 40	1 yr.	No kidney operation. Metastases in liver, intestines, and abdominal cavity.
" 42	6 mos.	No kidney operation. Metastases in pleura, opposite kidney, and ribs.
" 43	(?)	No kidney operation. Metastases in lungs, brain, and vertebrae.
" 44	1 1-2 yrs.	No kidney operation. Metastasis in lung.
" 45	(?)	No kidney operation. Metastases in femur (spontaneous fracture), ribs, and glands.
" 46	5 mos.	No kidney symptoms. Metastases in lungs, brain, and vertebrae.
" 82	7 mos.	No kidney operation. Metastases in clavicle and lungs.
" 90	2 yrs.	No kidney operation. Metastases in femur (spontaneous fracture), brain, etc.
" 91	6 mos.	No kidney operation. Metastases in lungs, iliac bone, and bladder.
" 121	1 yr.	No kidney operation. Metastasis in jaw.
" 123	1 yr.	No kidney operation. Metastases in femur (spontaneous fracture) and vertebrae.
" 129	5 yrs.	No kidney operation. Metastases in clavicle, etc.
" 132	7 mos.	No kidney operation. Metastases in lungs.
" 157	(?)	No kidney operation. Metastases in femur, lungs, etc.
" 175	6 mos.	No kidney operation. Metastases in vertebrae, etc.

It is plain, from this table, that in the majority of cases in which there are serious metastases the disease runs a rapid course.

Physical Examination

The relation of the tumor to the intestines is quite important, but the importance has been somewhat overestimated. The colon usually lies in front and to the inner side

of the kidney tumor, and when the colon is distended with gas there is a distinct tympanitic note in front of it. Absence of tympany may be due either to the fact that the colon is collapsed, or else that it is filled with fecal matter. Artificial distension of the colon with air has not proved as much of an aid in diagnosis as it at first promised. Thus, Guillet[1], in a series of thirty-six cases of renal tumor, found only eleven in which there was tympany in front of the tumor. In thin patients, with lax abdominal walls, when the intestine is not distended with gas a thick cord sometimes marks the direction of the colon. Exceptionally, a right renal tumor may, as it grows, push the ascending colon downwards instead of forwards and inwards, while a left renal tumor may push it outwards; and finally, a tumor of either kidney may push the bowel inwards toward the median line, in which event there is no resonance over the growth.

Before examining the kidney region for renal tumor the bowel should be properly evacuated. When properly prepared, the patient should first be placed in the dorsal position, and an endeavor should be made to appreciate the outlines of the mass by palpating the abdomen. Guyon's[2] method is a good one and gives much information. In examining the right kidney the left hand is placed under the patient in the angle formed by the ribs and the lumbo-sacral muscles, while the right hand is placed in front of the tumor; the left hand now gives a succession of quick strokes while the right hand endeavors to appreciate the form and outline of the tumor pressed against it.

Israel's[3] method is likewise of service and in skilled hands will perhaps give the best results. The patient is placed upon the sound side with the knees and thighs flexed, and he is told to breathe slowly and quietly through the mouth, making an endeavor to relax the abdominal muscles as much as possible. If the left kidney is to be examined the

[1]Th. de Paris, 1888,, p. 52.
[2]Maladies des Voies Urinaires, Paris, 1896, Vol. 2, p. 260.
[3]Berlin. klin. Woch., 1899, Vol. 26, p. 126.

patient lies on his right side and the examiner stands behind him, at the same time facing towards his head. The fingers of the right hand are now placed flat on the left lumbar region, while the left hand is placed on the abdomen in such a position that the tips of the index and middle fingers will be placed at a point two fingers' breadths below the junction of the ninth and tenth ribs and cartilages. The patient is now told to inhale deeply while the lumbar hand presses forwards toward the abdominal cavity; exactly at the time when inspiration goes over into expiration, the hand below the ribs compresses the abdominal muscles gently and firmly toward the lumbar hand, and at the same time the abdominal fingers make slight movements of flexion and extension at the metacarpo-phalangeal joints, in an endeavor to find the lower edge of the kidney, which reaches its lowest point at the end of inspiration; when the kidney begins to ascend it slips by the abdominal hand, and can be recognized, and any irregularity of its surface can be appreciated. The best time to palpate is just at the beginning of expiration, for it is then that the kidney begins to ascend, having reached its lowest point; at this time also the abdominal walls are most relaxed.

This method is especially applicable to small tumors just beginning to grow. Israel[1] records a case in which a malignant growth the size of a cherry, situated on the anterior surface of the kidney, was palpated by this method, and afterwards successfully removed. The kidney was high up and fixed by adhesions.

The phonendoscope has lately come into use and has in some instances been of service in outlying a tumor. Too much must not be expected of it.

Photographing the tumor with the X-Ray has not up to the present time been done many times. Occasionally shadows of nodules may be seen on the photographic plate. This method of diagnosis has not been used as frequently

[1]Dtsch. Med. Woch., 1896, Vol. 22, p. 345.

as it deserves. Hardon[1] was successful in photographing hypernephromatous nodules. Keen, Pfahler, and Ellis[2] also got a shadow and thought the disease must be gall stones. The writer[3] also got a positive shadow with a large hypernephroma of the left kidney. On the other hand Lilienthal[4] took an X-ray picture of one of these tumors with a negative result, and so likewise did Taylor[5]. When a positive result is obtained it is evident that there is some disease requiring surgical intervention, but the presence of a shadow is not in itself indicative of any special disease. Tuberculous nodules in the kidney sometimes throw a shadow, and so likewise occasionally do gall stones, and particularly calculi in the kidney.

The presence of metastases of hypernephroma in the lungs may sometimes be discovered by the X-Ray. Barjou[6] detected nodules in the lung in a case in which there was a large kidney tumor. A diagnosis of hypernephroma was made, which proved to be correct.

The urine does not vary much in malignant disease of the kidney, and, barring the presence of blood, abnormalities are infrequent. The daily amount is normal, as a rule, and the solid constituents do not vary much from the average, unless the disease is well advanced. Albuminuria is occasionally present and is abundant when there is much blood. Glycosuria has occasionally been observed. Casts and renal elements may be found on the diseased side when there is inflammation of the renal parenchyma around the growth. A nephritis of the opposite kidney is sometimes observed, as Albarran[7] has pointed out, the nephritis here being due to general toxemia, a condition caused by the malignant disease. Anuria on the side affected by the growth

[1]Ill. Med. Jour., 1903-4, Vol. 5, p. 909.
[2]Am. Med., 1904, Vol. 8, p. 1040.
[3]Am. Jour. Urol., 1906, Vol. 2, p. 246
[4]Am. Jour. Dermat. and Gen. Ur. Dis., St. Louis, 1904, Vol. 8, p. 160.
[5]Am. Jour. Med. Sci., 1906, Vol. 131, p. 210.
[6]Lyon. Méd., Vol. 102, p. 743.
[7]Tr. Ass. Franç. d'Urol., 4th Sess., Paris, 1889, p. 509.

may be observed, especially when the growth is of considerable size. Brown[1] records a case in which there was total anuria on the side affected by the growth; the writer has also observed a similar instance in his own practice. Pus is found in the urine when there is coexisting pyelonephritis, but this is very rare. Bovée[2], operating on a patient, found a hypernephroma in which there were seven pus pockets; in the pelvis of the kidney there was a small mulberry calculus which had completely blocked the entrance to the ureter. Fragments of the growth floating in the urine are of extremely rare occurrence, but they are of great diagnostic importance when they are found. It has even been denied that they are ever found, but Grawitz[3] has recorded a case of this kind.

A cystoscopic examination is most important and it gives information of decided value.

The cystoscope will frequently discover blood exuding from the ureteral orifice of the affected side. The blood exudes with the urine in the form of a jet which swirls into the fluid medium in the bladder. Occasionally a clot will be seen projecting from the orifice in the form of a long string, lying on the floor of the bladder. The appearance of this phenomenon is unmistakable. Sometimes the clot has become partially decolorized, and it will then have a grayish sponge-like appearance.

If the hemorrhage is not going on when the cystoscopic examination is made, the appearance of the ureteral orifice of the affected side may give some evidence of a recent hemorrhage, especially if there has been a clot formation. In these cases the edges of the orifice may be roughened and eroded-looking, and besides this there may be considerable redness in the vicinity of the opening. In the absence of these signs some information as to the side affected may be furnished by studying the orifice, particularly with refer-

[1]Ann. of Surg., 1904, Vol. 39, p. 299.
[2]Surg. Gyn. and Obst., 1906, Vol. 3, p. 99.
[3]Virch. Arch., 1883, Vol. 93, p. 50.

ence to the expulsion of urine. With a healthy kidney the rate of discharge of urine from the orifice is comparatively well regulated. The jets recur at stated periods and the urine is expelled with considerable force into the bladder. The ridge on the outer side of the ureter swells and the area around the ureteric opening is drawn downwards and at the same time the orifice becomes rigid and the mouth opens; then the jet is expelled. This recurs every few seconds. Variations in rhythm are sometimes seen in disease. A ureteral orifice which is acting sluggishly should be under suspicion, especially if its fellow is acting normally. Long intervals between jets, feeble movements of the ureteral mouth and small amounts of urine expelled are suggestive of damaged kidney, even if the urine is apparently clear. The writer has frequently seen these signs and they may almost be regarded as pathognomonic of damaged kidney. Varicosity of the orificial veins is also extremely suggestive of renal tumor, as first pointed out by Fenwick[1].

In the absence of macroscopic blood in the urine in a case in which hematuria is known to have occurred, the finding of microscopic quantities in the separated urine sometimes throws light on the case. In most males separation is perhaps best accomplished by passing the ureteral catheters, although this method is open to the objection that the catheter may cause trauma and give rise to confusing hemorrhage. In the female it is sometimes well to use an intravesical separator and of these the best instrument is that devised by Luys[2]. If the instrument is properly introduced into the bladder, which has previously been distended with fluid, with the patient in the dorsal position with the shoulders raised, no hemorrhage need be caused by the instrument, and all blood discovered in the sediment will be that proceeding from the affected side. The writer's experience with this instrument covers a period of several years and he is

[1]Personal communication.

[2]Georges Luys. La Separation de L'Urine des deux Reins, Paris, 1904, p. 66.

fully satisfied with it. The ease with which it can be introduced, with insignificant discomfort to the patient, and the admirable results which may be obtained with it, when properly used, leave very little to be desired.

The injection of fluid into the renal pelvis is of great diagnostic importance, for it accurately locates the seat of disease.

Injection into the renal pelvis of a solution containing bismuth in suspension, by means of a long catheter, and immediately afterwards taking an X-ray picture of the growth, may serve to indicate its position and its relation to the renal pelvis. There is some danger, however, that the bismuth may subsequently form the nucleus of a calculus. Voelcker and Leichtenberg[1] call attention to this danger, and also refer to the poisonous character of the soluble bismuth compounds, which contraindicates their use. They recommend instead a two per cent. solution of collargolum as especially adapted for this purpose, this solution causing no irritation whatever, and giving a distinct picture which is equal to that given by bismuth in suspension.

The injections into the renal pelvis serve a double purpose, that just mentioned, and also, as first pointed out by Kelly[2], the information which it gives with regard to the character of the pain. If the injection causes pain similar to that occasioned by the growth, this is corroborative evidence that the seat of the disease has been accurately located; if, however, the pain following the injection is decidedly different in character, a disease affecting some neighboring organ may be suspected.

Diagnosis

The diagnosis of hypernephroma is one of the most difficult to make. In arriving at a conclusion the subjective rather than the objective phenomena are most important,

[1] Munch. Med. Woch., 1905, Vol. 52, p. 1576.
[2] Johns Hop. Hosp. Bul., 1889, Vol. 10, p. 116.

and little reliance is to be placed on the physical signs. A most careful analysis of the case is essential, and it is by weighing the symptoms in the aggregate rather than singly that a correct estimate of their importance may be gained.

A patient in the prime of life, suffering from intermittent hematuria which is known to be of renal origin, if he has little or no pain and no renal retention, and if the hematuria cannot be accounted for by the presence of any other kidney disease, may be suspected to be affected with a suprarenal growth in the kidney.

The previous urinary history should be carefully inquired into, especially with reference to hematuria. The general state of the health of the patient is important; in the first stage of the disease it has been stated that the general health is usually excellent, and a history of gradual decline not subject to periods of better health is significant of malignant trouble. Cachexia may be absent for a long time. In the early stages of the disease a diagnosis may be well-nigh impossible.

A thorough physical examination will sometimes reveal a great deal. Examination of the lungs, liver, and bones should be made. Here the X-ray may be serviceable. A careful search for the enlarged glands along the vertebral column, iliac fossae, groins, axillae, and subclavicular regions should not be neglected. Metastases should be searched for, as they are sometimes the first symptom of the trouble.The presence of varicocele, especially on the right side, is significant.

The presence of portions of the growth in the urine, although rarely seen, is very significant.

There has been great disinclination on the part of many surgeons to employ the exploratory incision in cases of doubt. In view of the comparatively harmless nature of this procedure, it would seem as though it ought to be used much more frequently. An obscure unexplained hematuria which is known to be of renal origin should excite the

gravest alarm, and if it cannot be accounted for, exploration through an incision in the loin should be promptly resorted to.

In the absence of hematuria hypernephroma is extremely difficult to diagnose, and it has been mistaken for almost every other form of abdominal enlargement. In arriving at a correct conclusion we are in many cases aided by noting the relation of the growth to the intestines. The relative position of the colon to the tumor, while it does not give all the diagnostic aid which has been claimed for it, yet is a distinct help. The ascending, transverse, and descending colons form three sides of a square, thus dividing the abdominal cavity into four regions, a central, superior, right, and left lateral. A tumor originating in one of these regions may crowd over into another, but only by pushing away the colon. The large intestine, as a rule, retains its position quite well in consequence of the fairly fixed nature of the mesocolon. Uterine and ovarian tumors must be in the central region, with the colon bounding them above and on the two sides. The kidney is normally situated behind the colon, and when enlarged by a tumor it must develop in the layers of the ascending or descending colon; hence the colon will be found in front of the tumor or toward its inner side. Tumors of the liver crowd the colon down, and may override it; tumors of the stomach also crowd the colon down; while tumors of the pancreas almost invariably appear above the transverse colon and in a few instances behind it. A tumor growing in a movable kidney may enter the central zone, but unless fixed it can be slipped back in position. Tumors of the adrenal push the colon forward and inward. The central region, besides uterine and ovarian tumors may contain growths of the small gut, the mesentery, omentum, and also enlarged retroperitoneal glands. The spleen must be on the outside of the descending colon, but if greatly enlarged may override it entirely; there is no line of resonance between the

kidney dullness and the vertebral spine, as there nearly always is in the case of splenic enlargement. Tumors ordinarily close to the abdominal wall may in consequence of adhesions be separated from it by intestines; in this case there will be tympany in front of them. Tumors of the spleen, liver, and uterus, may present these characteristics, and especially tumors of the ovary.

The two diseases most frequently confounded with hypernephroma are calculus and tuberculosis, and in both of these hematuria is sometimes the first symptom. By closely watching the patient the diagnosis can usually be made.

Tuberculosis of the kidney is most common in youth, between the ages of twenty-five and thirty-five, and is diagnosed by the presence of abundant pyuria and especially by finding the tubercle bacilli in the sediment of the urine. The inoculation of guinea pigs is likewise conclusive. The presence of tubercular foci in other parts of the body is the rule and is of great diagnostic help.

In calculus disease the movements of the body exercise a marked influence on the amount and character of the hematuria. Walking or motion of any kind is apt to bring on an attack of the bleeding, in this characteristic differing from the hematuria of hypernephroma. Nephritic colic or the passage of stone is significant. Following the Kelly[1] method one should never neglect to pass the wax-coated ureteral bougie in doubtful cases, noting whether the characteristic scratch marks are seen on the catheter.

Hematuria is sometimes a symptom of floating kidney, and here the cause is probably the congestion of the organ. The characteristic symptoms and signs of floating kidney are usually sufficient to distinguish this condition, but it should be remembered that hypernephroma may develop in a floating kidney. Fixation of the organ will put an end to the symptoms in uncomplicated cases.

Among the rarer causes of bleeding may be mentioned:

[1]Med. News, Phila., 1895, Vol. 67, p. 596.

essential hematuria, which, according to Malherbe and Legueu[1], is exceedingly rare, only a few instances having been positively diagnosed as such, and in which the only symptom is apparently causeless bleeding from the kidney; hemophilia, in which a clear history can usually be obtained of previous bleeding in other parts of the body from slight causes, and in which there generally is a family history of the complaint; infectious diseases, likewise rarely a cause of hematuria, although well authenticated and especially likely to occur after such diseases as small pox, typhoid fever, malaria, etc.; neuroses of the kidney, in which a strong hysterical element can usually be obtained, with other signs and symptoms of hysteria in other parts of the body, notably with reference to the control of the urine in the bladder; parasites, whose presence is especially common in warm climates, especially the parasite Bilharzia, which may be detected by careful examination of the urine; the bleeding of pregnancy, a rare occurrence, due to the congestion of the organ; the hematuria occasionally seen in chronic nephritis, the possibility of which should always be borne in mind in differentiating hypernephroma, and the diagnosis of which may be made by a careful analysis of the urine, as well as by a thorough examination of the rest of the body; pernicious anaemia, whose presence may long occasion doubt as to the correct diagnosis on account of the exhausting symptoms to which it gives rise, but the diagnosis of which is greatly aided by the examination of the blood; renal pelvic growths, whose occurrence is very rare, but whose symptoms at all stages of the disease are so similar to those of renal growth that differential diagnosis is almost impossible; the bleeding from renal retention due to congestion, the origin of which must be sought in a strictured condition in some part of the urinary passage; and finally, pyelonephritis, the diagnosis of which depends upon the etiology of the disease, the examination of the urine, and the symptoms of severe prostration

[1] Ass. Franç. d'Urol., Paris, 1899 p. 7.

attended with fever to which it may give rise. Polycystic disease of the kidney is occasionally mistaken for malignant growth. Hemorrhage, however, is not so common in this disease, but it resembles the bleeding of malignant tumor in that it is apt to come on without cause. The symptoms resemble those of chronic interstitial nephritis; in some cases the double character of the tumor and its botryoidal character are distinguishing features.

When we come to differentiate the various tumors which are not of evident renal origin, and in which the symptom hematuria is absent, a large field for speculation is opened. Bearing in mind the relation of the colon to the growth, an endeavor should be made to locate the tumor with some degree of accuracy.

Among the rarer forms of kidney tumor which must be differentiated are dermoid cysts, which are so rare that they may be practically disregarded; hydatids, which are very rare, and whose presence is sometimes detected by finding hooklets in the urine; serous cysts of the kidney, which may fluctuate, are quite movable, and which do not disturb the general health to any marked degree; lymphadenoma and malignant lymphoma, which are simply parts of the general disease luekemia or pseudoleukemia, and which cause enlargement of both organs, and in which diagnosis may be made on examination of the blood, and by noting the condition of the other organs of the body; syphilis of the kidney, which is a rare disease and which may be diagnosed by the favorable action upon it by the iodide of potash.

Paranephritic growths are usually impossible to differentiate; they are extremely rare, and many of them present all the symptoms of renal tumors; they are more frequent in women, and sometimes reach an enormous size.

The remaining tumors affecting the abdominal contents are numerous. Omental tumors are apt to be movable laterally and in an upward direction, while they project prominently against the anterior abdominal wall. Ovarian tumors

are usually situated in the central zone of the abdomen, and are surrounded by the colon; there may be a history of menstrual difficulty, and close questioning may reveal the fact that the tumor was first noticed in the lower part of the abdomen and gradually rose. Errors in the diagnosis of ovarian tumors may occur in cases in which malignant disease develops in a movable kidney; in such cases the kidney slips into the central zone, underneath the peritoneum. Tumors of the abdominal wall become fixed when the abdominal muscles are contracted, and when they are superficial they do not tend to disappear under these circumstances as do the tumors of the abdominal cavity. Cancer of the large intestine may give rise to confusion on account of the situation and mode of increase; it rarely has the form of the kidney, however, and diarrheal discharges tinged with blood serve to differentiate it in a measure; the cancerous mass may move about freely, and this is a distinguishing feature. Liver and gall bladder diseases are difficult to discriminate; jaundice, of course, is a characteristic sign, but it sometimes appears with a renal growth when the disease has involved the bile ducts; a differential sign in the case of liver tumor is the absence of tympany between the liver and the tumor, and also the absence of ballottement, although neither is positive, for the intestine may be present between the liver and the tumor when the latter has sprung from the lower surface of the organ; the sharp edge of the liver is characteristic; tympany between the tumor and the lower border of the liver is sometimes of diagnostic value in differentiating gall bladder tumors. Mesenteric tumors are more often median, and move in a lateral direction, having, as a rule, resonance all around them; malignant growth in a movable kidney is more apt to be mistaken for these tumors than one which is fixed. Enlarged retroperitoneal glands are usually central, and are surrounded by a zone of tympany; an explanation of their presence should be sought in the causes for their enlargement, such as tuberculosis

elsewhere in the body. Pancreatic tumors are situated above the colon, are more median in position, and it is only with the left-sided tumor of the kidney that confusion is likely to arise; obstruction of the common bile duct is not unusual, and may help in diagnosis. Splenic tumors are frequently mistaken; they usually have a rounded surface with a sharp edge, notched in places, and in practically all cases of enlarged spleen there is no intestine in front of it, while there is nearly always a line of resonance between the splenic dullness and the spinal column; ballottement is absent; and finally, a splenic tumor is movable, and will not cause varicocele. Uterine tumors may fall into the loin and may be covered by the small intestine when they are pedunculated; a careful examination will sometimes discover their connection with the uterus, and characteristic symptoms may lead to the diagnosis.

The differential diagnosis between the various kinds of growth in the kidney is in most cases purely speculative. Sarcoma is more apt to occur at a younger age than carcinoma, which is commonest between forty and seventy. Hypernephroma may develop at any age, but is most common in the fifth and sixth decades. Adenomatous growths are more apt to occur earlier in life, and do not so readily give rise to metastases. Hematuria is a prominent symptom of carcinoma, and the disease is apt to undermine the system more quickly than is the case with other tumors. Cachexia appears early. A bone metastasis is evidence of hypernephroma rather than of carcinoma or sarcoma, particularly if the patient is in the early stages of the disease and is not yet cachetic. Glandular involvement with cachexia rather favors sarcoma and carcinoma, but not malignant adenoma. In general large tumors speak against carcinoma. Infiltrating cancer of the kidney does not give rise to a large growth, but early extends to the surrounding tissues and causes general infiltration. The sarcomata are sometimes very large, not only in consequence of growth of the tumor proper, but also

on account of the infiltrated surrounding tissue. Hypernephromata, on the other hand, have in many instances a very slow growth and may remain for several years unchanged in size. Hypernephroma is more apt to be freely movable than the other forms of growth, but this is by no means a general rule. Carcinoma, sarcoma, and malignant adenoma are more frequently attended with hematuria than is the case with hypernephroma. A long period of time between the first attack of hematuria and the second one is suggestive of hypernephroma rather than the other forms of tumor; in the latter the intervals between the attacks are usually quite short.

Treatment

Palliative treatment offers no hope of cure. We have seen that the disease may last a considerable number of years before death ensues, if operation is not performed. Hematuria of itself rarely causes death, but it hastens the end if the symptom is prominent. The metastases are really of more importance than the disease in the kidney, if they are well advanced, especially metastases in important vital organs, such as the lungs, the liver, etc. In these cases the whole course of the disease may not extend over more than a few months' time.

Early operation gives the best results. If the upper pole of the kidney is alone involved an early diagnosis is very difficult, as the tumor is inaccessible and cannot be easily palpated. The disease may even spread to a neighboring organ under these circumstances, and no tumor may be felt by the examiner. In such cases of doubt, should there be localizing symptoms, an exploratory operation should not be too long deferred. Hematuria is the surest indication that operation is needed, and if the source has been determined and the exact diagnosis of the case is doubtful, an exploratory operation is imperative. Better technique tends to better results. A small tumor which is enclosed within the capsule of the

kidney is less likely to recur than a large one which has already begun to invade the tissues.

Operation in the hopeless cases is sometimes indicated if the tumor is causing intolerable pain, and a palliative operation, with the removal of as much tissue as possible, will sometimes result in unlooked-for relief. If the disease has extended widely and is not occasioning too much suffering, the patient had better be left alone, for there is danger in such cases of fatal hemorrhage on the operating table, or of death soon afterward from shock or collapse. Well advanced cachexia is a contraindication, and so also is the presence of metastases in different parts of the body; invasion of the veins should also bar operation; nephritis affecting the opposite kidney should be looked upon as most unfavorable to prognosis, for even if slight, rapid death may follow if an operation is performed.

As to the choice of route, the lumbar or the transperitoneal, opinion has materially changed within recent years. Some years ago the lumbar route was the route of choice, but lately the transperitoneal has had many adherents. Albarran and Imbert[1] reviewing the results of the two operations find that in 129 cases in which operation was done by the lumbar route, the mortality was 22 per cent., while in 84 cases in which the abdominal route was selected, the mortality was 23 per cent. But, as Albarran and Imbert point out, the abdominal cases were for the most part very difficult ones, in fact the most difficult, both from the size of the tumors, and from the complicating adhesions etc. They therefore believe that the two routes offer practically the same mortality. Small tumors should always be attacked by the lumbar route. Large ones will require the abdominal incision.

Lately the paraperitoneal method of doing nephrectomy has been employed with success, and it ought still further to reduce the mortality of the operation. The incision extends

[1]Les Tumeurs du Rein, Paris, 1903, p. 381.

from the free border of the ribs nearly to the anterior superior spine of the ilium and just a little outside the linea semilunaris. The tissues are cut to the peritoneum. The latter is now detached with the hand as far out as its reflection from the lateral aspects of the abdomen; it is then drawn toward the median line and is retained there with large pads and retractors. The intestines including the colon are drawn away with the peritoneum and the kidney is exposed. If more space is needed a second incision may be made at right angles to the first one, beginning a little above its centre; it may extend as far out as the edge of the quadratus lumborum muscle if required. If the peritoneum is opened it may be stitched at once.

The incision used in peforming lumbar nephrectomy will vary according to the individual preference of the operator. There are several incisions. An incision extending from a point about four fingers' breadths from the vertebrae, starting below the twelfth rib, and running downwards to about the middle of the iliac crest, passes just outside the erector spinae sheath, which must not be opened. The structures divided are the lower part of the latissimus dorsi, a few fibres of the external and internal oblique, and a few fibres of the serratus posticus inferior. Beneath the internal oblique lies the ilioinguinal nerve which lies on the transversalis fascia. This is to be drawn aside and not injured. On dividing the transversalis fascia the outer edge of the quadratus lumborum muscle is exposed, and this muscle serves as the chief guide to the kidney. If more room is needed the incision just described may be enlarged by an additional one extending from its upper end, forwards and inwards, and parallel with the twelfth rib.

A favorite incision with some operators starts at the outer edge of the erector sheath, just below the twelfth rib, and extends parallel with the rib in an oblique direction downwards towards the anterior superior spine of the ilium. This gives a good deal of room and is of advantage in cases

in which there are adhesions. If it is desired to get more room in the region of the kidney, this may be accomplished by a second cut, starting from the superior end of the first cut and running down nearly parallel with the erector spinae sheath, in other words practically the same incision as the first incision described.

If the abdominal operation has been selected, the incision will be in the linea semilunaris. The intestines are drawn away and held out of the field by pads. The outer leaf of the mesocolon is now divided, taking care not to injure the blood vessels in those cases in which the two leaves of the mesocolon are closely approximated. The incision in the mesocolon may be at right angles to the colon itself or parallel with it. The former gives less room, but is less dangerous with reference to wounding blood vessels. The kidney is now exposed. By suturing the cut edges of the anterior peritoneum to those of the posterior, the operation may be made extraperitoneal. When the operation is over the stitches may be removed and both openings closed. A counter opening in the loin secures drainage and the abdomen is closed tight. If there is no time to do this, a gauze drain may be passed into the wound and may remain *in situ* for a few days.

In lumbar nephrectomy if the kidney is not infected, the wound may be closed tight without drainage. If drainage is needed, a piece of gauze may be passed in at the lower angle and allowed to remain.

In isolating the kidney it is best to work with the fingers, tying vessels as progress is made. It is well to keep close to the capsule and anomalous vessels should be searched for and tied. When the pedicle is reached, it should be freed as much as possible. The ureter is tied a short distance from the kidney; it lies behind the vessels, but before cutting it a clamp is put on above the ligature and the ureter is cut between the ligature and clamp. Cutting away the ureter allows the kidney to come up considerably and the pedicle

should now be ligated. If it is large, it is better to tie in sections, using an aneurism needle or a Cleveland holder. If the vessels can be isolated they may be tied separately, or, if the pedicle is a small one, a single ligature will suffice for both veins and arteries.

The difficulties attending operation for removal of hypernephroma of the kidney are many. If there is a large mass of enlarged glands around the hilus of the kidney a good deal of difficulty may be experienced in separating them from the renal vessels, and the danger of hemorrhage is considerable. Furthermore, one can never tell if a growth has extended into the vessels themselves, and if it has, there is considerable danger of sudden death from embolism at the time of operation, to say nothing of the impossibility of removing the growth if it has extended beyond the junction of the renal vessels with the large trunks. Bearing this in mind, the pedicle should be ligated, if practicable, as near the aorta as possible as soon as the abdomen has been opened. All tissue about adhesions should be removed with the greatest care because in them may be tumor tissue which will be sure to give rise to further extension of the disease. The capsule must in all cases be removed with the kidney, because the tumor may have invaded it. In the case of large growths there may be very large veins traversing the capsule in various directions; these should be ligated twice, and the vessel cut between the ligatures. It is best to remove the suprarenal capsule and the fatty capsule as well, in order to be sure that no bits of the tumor are left behind. In a case in which there are extensive adhesions, all of which cannot possibly be removed, especially when the growth is a large one and the lymph glands are involved, it is far better to abandon the operation, for the prolongation of life is not to be hoped for here, and the operation, which is sure to be a severe one, may end in immediate death. The only exception to this rule should be severe pain, which is likely to be relieved by removal of the growth.

The mortality attending the operation has been much reduced in late years owing to improvement in technique and to a better selection of cases.

In the list of 176 cases compiled by the writer there were 143 nephrectomies, with 33 operative deaths, or 23 per cent. By operative death is meant death occurring within two months from the time of operation. The mortality would probably be found to be much less than 23 per cent. in the cases operated on during the past few years. The mortality here presented covers a period of about fifteen years.

The immediate cause of death in these cases is operative shock, or collapse from hemorrhage. Death from cardiac failure has occurred in a number of instances, either a few days or weeks after operation. Albrecht[1] thinks it occurs not infrequently and he quotes Israel, who likewise thinks it not uncommon. Israel found changes in the cardiac muscle in cases in which death followed the operation.

Partial nephrectomy need be considered only when there is a single kidney and the growth is well localized at the poles. Secondary operations may be required, but only to relieve suffering.

Prognosis after Operation

The same disappointments are seen after operation for hypernephroma of the kidney as in maligant disease of other parts of the body. One can never be sure that the disease will not return after a most thorough operation, even after the lapse of a considerable period of time.

The prognosis in all cases depends largely on the thoroughness with which the operation has been performed. Unfavorable cases are those in which the operation has not been thorough, or in which it has been undertaken too late. Tumors affecting the lower pole of the kidney are much more favorable as regards prognosis than those affecting the upper pole; for not only is the disease recognized earlier,

[1]Verh. d. Dtsch. Ges. f. Chir., Berlin, 1905, Vol. 34, p. 651.

but also a completer and more thorough operation can be performed as the field is more accesible.

The disease is a most serious one, and it is not, as some writers would have us believe, more benign in its remote results than the various other forms of malignant diseases affecting other organs of the body.

Most of the cases reported have been operated upon too late to have obtained the best results. This means that the diagnosis has not been made early enough, or that there has been too great timidity in approaching the operation.

The analysis of any table which has been compiled from a series of reported cases is necessarily unsatisfactory, owing to the fact that many of the reports are incomplete. Statistics never show the exact situation, and rarely do more than give an approximate idea of the subject. The following tables are offered, therefore, with the knowledge of the inaccuracies to which tables are liable; nevertheless, they will give some idea of the true conditions.

In the list of 176 cases there were 143 nephrectomies, which may be tabulated as follows:

Immediate operative deaths	33
Died later after operation	43
Survivals	31
Result not stated	36
Total	143

TABLE SHOWING LENGTH OF TIME THAT ELAPSED BETWEEN NEPHRECTOMY AND DATE OF DEATH.

1 year or under	22
1 to 2 years	11
2 to 3 years	6
3 to 4 years	1
4 to 5 years	1
7 to 8 years	1
10 to 11 years	1
Total	43

It is interesting to note the causes of death in these cases. This is shown in the following table:

Metastasis	33
Pneumonia	1
Cardiac affection	1
Pulmonary tuberculosis	1
Uremia	1
Cerebral embolism	1
Not stated	5
Total	43

It is to be noted that there were no deaths from rupture of arteries. This does not bear out the statements of some writers that death from cerebral hemorrhage in hypernephroma of the kidney is of frequent occurrence.

The malignant nature of the disease is proved by the late occurrence of the metastases in some of the cases. The following table shows this at a glance:

TABLE SHOWING LENGTH OF TIME THAT ELAPSED BETWEEN NEPHRECTOMY AND DEATH FROM METASTASIS.

1 year or under	17
1 to 2 years	8
2 to 3 years	4
3 to 4 years	1
4 to 5 years	1
7 to 8 years	1
10 to 11 years	1
Total	33

Clairmont's[1] case was quite remarkable. The patient was a male thirty-nine years of age, greatly reduced by hypernephroma of the kidney, but who nevertheless had submitted, in his reduced condition, to a nephrectomy ten years previously. At the operation the diaphragm was accidentally opened and Clairmont thought that infection gained access through the lymphatics at that time. After a period of ten years of perfect health the patient died from the ef-

[1]Arch. f. klin. Chir., 1904, Vol. 79, p. 620.

fects of hypernephromatous deposit in the peribronchial lymph glands. It seems unnecessary to the writer to explain the source of infection in this way, for in a number of instances the bronchial glands have been infected without there having been any such accidental cause to explain their infection. Hoffman[1] reports such a case in a patient upon whom no operation had ever been performed.

Not less remarkable in point of view of long interval between operation and death from metastasis was Albrecht's[2] case in a female forty-four years of age who was operated upon for the disease after having had symptoms only two months. She survived the operation, lived in a state of perfect health for a period of seven years, and then died from the effects of a deposit of the growth in the dorsal vertebrae. This case may be said to have been an exceptionally favorable one for operation, with every chance for recovery because the disease was attacked early in its course. It illustrates, however, that nephrectomies performed early may at least give the hope of a long survival. Another of Albrecht's[3] patients died from recurrence at the site of operation four years and three months after the nephrectomy.

This malignant feature of the disease is corroborated by Scudder[4], who followed twelve cases of hypernephroma of the kidney after nephrectomy. They all died from metastases except one, and that was a recent case.

It has been the custom to consider as cured, patients who have passed the three year limit after removal of malignant tumor, and this limit has been applied to hypernephroma of the kidney. The cases mentioned disprove this assertion. Israel[5] in a list of twenty-two cases of hypernephroma of the kidney reports fourteen in which death occurred after the three year limit. It would seem that the assertion may be

[1]Dtsch. Med. Woch., 1907, Vol. 33, p. 303.
[2]Ver. d. Dtsch. Ges. f. Chir., 1905, Vol. 34, p. 670.
[3]Loc. cit., p. 704.
[4]Ann. of Surg., 1906, Vol. 44, p. 855.
[5]Chir. klin. d. Nierenkrankheiten, Berlin, 1901, p. 481.

justly made, in view of the facts presented, that an individual who has had nephrectomy performed for removal of the diseased organ, even if the operation has been an early and a thorough one, is never to be considered safe from the danger of a recurrence of the disease.

The following cases of survival after operation were taken from the writer's table:

TABLE SHOWING SURVIVAL AFTER OPERATION.

Survival.	*Number of cases.*
1 yr. or under	9
1 to 2 yrs.	6
2 to 3 yrs.	7
3 to 4 yrs.	2
4 to 5 yrs.	3
5 to 6 yrs.	2
6 to 7 yrs.	1
9 to 10 yrs.	1
Total	31

In one of these cases, reported by Albrecht,[1] a remarkable feature was the survival of the patient after removal of a bone metastasis in the scapula which had shown itself four years after the nephrectomy; two years and seven months after this second operation the patient was still in a good state of health. This is an unique case.

[1]Verh. d. Dtsch. Ges. f. Chir., 1905, Vol. 34, p. 702.

CASES OF HYPERNEPHROMA

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result
1	Albrecht-Verh. d. Dtsch Ges. f. Chir., 1905, vol. 34, p. 670	Male	36	A few weeks	Right	Yes	Yes	No		Nephrectomy	Lungs	Death (operative)	
2	Albrecht-Verh. d. Dtsch Ges. f. Chir., 1905, vol. 34, p. 670	Female	44	2 mos.	Left	Yes	No	2 mos.	No	Nephrect.	Dorsal vertebrae. Paralysis of all the extemities. This did not occur until the end	Recovered operation	Died 7 years later
3	Albrecht-Verh. d. Dtsch Ges. f. Chir., 1905, vol. 34, p. 671	Female	51	5 mos.	Left	Yes	Yes	No	No	Nephrect.	No	Recovery	Died 2 years later. pneumonia. Autop.
4	Albrecht-Verh. d. Dtsch Ges. f. Chir., 1905, vol. 34, p. 672	Male	60	5 years	Left	Yes	Yes	No	Spontaneous fracture. l. femur. Recovery. Well 5 yrs. Then tumor rt. femur with fracture. Tumor l. humerus and occiput	None	Both femurs, l. humerus, occiput, brain lungs, omentum, pancreas, and heart	No operation on kidney	Died at end of 5 yrs. Autopsy
5	Albrecht-Verh. d. Dtsch Ges. f. Chir., 1905, vol. 34, p. 677	Female	53	5 mos.	Left	Yes	No	5 mos.	None	Nephrect.	Occiput	Recovery	Died in 6 mos.

CASES OF HYPERNEPHROMA. (Continued)

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result
6	Albrecht-Verh. d. Dtsch Ges. f. Chir., 1905, vol. 34, p. 682	Male	42	2 yrs.	Right	Yes, 8 mos.	Not stated	Yes, 2 yrs. after exertion	None	Nephrect.	Yes, not stated	Recovery	Died 1 yr. 8 mos. later, metastases
7	Albrecht-Verh. d. Dtsch Ges. f. Chir., 1905, vol. 34 p. 683	Male	42	1 yr.	Left	No	No	No	No kidney sympt'ms	None	Right frontal region	No operation on kidney	Died after operation on head. Autopsy
8	Albrecht-Verh. d. Dtsch Ges. f. Chir., 1905, vol. 34, p. 685	Female	35	7 mos.	Right	Yes	7 mos.	7 mos.	Chills and fever	Nephrect.	Not stated	Recovery	Died 9 mos. later. No details
9	Albrecht-Verh. d. Dtsch Ges. f. Chir., 1905, vol. 34, p. 686	Male	45	5 mos.	Left	5 mos.	Not stated	5 mos.	None	Nephrect.	5 mos. after op. met. to spinal col'mn Paralysis of legs	Recovery	Died in 5 mos. Met. to 10th dors. vert. Aut. met. mesenteric glands, liver and lungs
10	Albrecht-Verh. d. Dtsch Ges. f. Chir., 1905, vol. 34, p. 688	Male	43	3 yrs.	Left	2 yrs.	Yes	3 yrs.	None	Nephrect.	2 yrs. later, met. in scar	Recovery	Scar excised, died in 3 mos.
11	Albrecht-Verh. d. Dtsch Ges. f. Chir., 1905, vol 34, p. 688	Male	34	15 yrs. (pain in abdomen)	Left	1½ yrs.	15 yrs.	None	None	Nephrect.	Regional lymph glands	Death (operative). Autopsy	
12	Albrecht-Verh. d. Dtsch Ges. f. Chir., 1905, vol. 34, p. 689	Male	47	1 yr. 4 mos.	Left	1 yr. 4 mos.	No	No	None	Nephrect.	Glands about the spleen, liver glands, lungs	Death (operative). Autopsy	

CASES OF HYPERNEPHROMA. (Continued)

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result
13	Albrecht-Verh. d. Dtsch Ges. f. Chir., 1905, vol. 34, p. 690	Male	66	6 mos.	Left	Yes	Not stated	No	None	Nephrect.	"Multiple tumors in abdomen before death"	Recovery	Died 7 mos. later
14	Albrecht-Verh. d. Dtsch Ges. f. Chir., 1905, vol. 34, p. 691	Male	47	7 mos.	Right	Yes	Yes	No	None	Nephrect.	Lungs, retroperitoneal glands, and vena cava	Death	Died in 5 days Autopsy
15	Albrecht-Verh. d. Dtsch Ges. f. Chir., '05, vol. 34, p. 695	Male	18	6 mos.	Right	Yes	No	No	None	No oper. on kidney	Knee (amputation of leg), finger	Recovery from amputation. No oper. on kidney	Died 3 mos. later. Paralysis
16	Albrecht-Verh. d. Dtsch Ges. f. Chir., 1905, vol. 34, p. 696	Female	66	10 mos.	Left	No	No	No	None	No oper. on kidney	Left shoulder. Incision	Recovery	Died 2 mos. later
17	Albrecht-Verh. d. Dtsch Ges. f. Chir., 1905, vol. 34, p. 699	Male	40	7 mos.	Left	Yes	Yes	No	None	Nephrect.	None	Recovery	Well 5 mos. later
18	Albrecht-Verh. d. Dtsch Ges. f. Chir., 1905, vol. 34, p. 700	Female	54	2 yrs.	Right	Yes	Yes	No	None	Nephrect.	None	Death. (one week)	
19	Albrecht-Verh. d. Dtsch Ges. f. Chir., 1905, vol. 34, p. 701	Female	57	Several yrs.	Right	Yes	Yes	6 mos.	None	Nephrect.	Vena cava	Death (few hrs.)	

CASES OF HYPERNEPHROMA. (Continued)

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result
20	Albrecht-Verh. d. Dtsch f. Chir., 1905, vol. 34, p. 701	Male	45	4 mos.	Left	Yes	Not stated	No	Pain in left testicle	Nephrect.	None	Death (20 hrs.)	
21	Albrecht-Verh. d. Dtsch Ges. f. Chir., 1905, vol. 34, p. 702	Female	28	Several yrs.	Left	Yes	Sev'ral yrs.	No	None	Nephrect.	4 yrs. after nephrect. tumor of scapula, excised 2 yrs. 7 mos. later, good health	Recovery	Well 6 yrs. 7 mos. after nephrect.
22	Albrecht-Verh. d. Dtsch Ges. f. Chir., 1905, vol. 34, p. 704	Male	44	6 yrs.	Left	Yes	Yes	6 yrs.	None	Nephrect.	3 yrs. later recurrence at site of op.	Recovery	Died 4 yrs. 3 mos. after nephrect
23	Albrecht-Verh. d. Dtsch Ges. f. Chir., 1905, vol. 34, p. 706	Female	58	4 days	Left	Yes	Yes	Yes	None	Nephrect.	None	Recovery	4 yrs. later, well
24	Albrecht-Verh. d. Dtsch Ges. f. Chir., 1905, vol. 34, p. 707	Male	53	4 mos.	Right	Yes	Not stated	No	None	Nephrect.	Vena Cava Lungs	Died in 3 d'ys. Autopsy	
25	Albrecht-Verh. d. Dtsch Ges. f. Chir., 1905, vol. 34, p. 708	Female	58	Few mos.	Left	Yes	No	No	None	Nephrect.	None	Recovery	Well 2 yrs. later
26	Albrecht-Verh. d. Dtsch Ges. f. Chir., 1905, vol. 34, p. 709	Female	43	Not stated	Left	Yes	No	No	None	Nephrect.	None	Recovery	Well 1 year, 10 mos. later

CASES OF HYPERNEPHROMA. (Continued)

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result
27	Albrecht-Verh. d. Dtsch Ges. f. Chir., 1905, vol. 34, p. 710	Male	56	6 yrs.	Left	1 yr.	1 yr.	6 yrs.	None	Nephrect.	None	Recovery	1 yr. 2 mos. later, well
28	Albrecht-Verh. d. Dtsch Ges. f. Chir., 1905, vol. 34, p. 712	Male	28	6 mos.	Right	6 mos.	No	6 mos.	None	Nephrect.	Recurrence in scar 1y. 9 mos. after op.	Recovery	Died 2 yrs. 6 mos. later (recurrence in scar)
29	Askanazy-Zeigler Beitr., 1893, vol. 14, p. 33	Male	54	"Since boyhood"	Left	Since boyhood	No	1 yr.	None	Nephrect.	Lungs, pleurae, liver, diaphragm, peritoneum, site of oper.	Recovery	Died 4 mos. later
30	Bean-Northwest Med., 1903, vol. 1, p. 11	Female	42	6 mos.	Left	Yes	Yes	No	None	Nephrect.	None	Death (14 days)	
31	Bell-Can. Lancet, 1904-05 vol. 38, p. 900	Male	59	5 yrs.	Left	Yes	5 yrs.	1 yr.	None	Exploratory Incision	Not stated	Death (20 hrs.)	
32	Bell-Can. Lancet, 1904-05 vol. 38, p. 899	Male	50	5 yrs.	Left	Yes	Yes	5 yrs.	None	Nephrect.	"Recurrence in 4 mos."	Recovery	Died in 4 mos.
33	Bell-Can. Lancet, 1904-05 vol. 38, p. 899	Female	37	2 yrs.	Right	2 yrs.	Yes	No	None	Nephrect.	Not stated	Recovery	Not stated
34	Beneke-Zeigler Beitrag., 1890, vol. 9, p. 440	Male	53	6 yrs.	Left	Yes	6 yrs.	No	Dyspnoea. Ascites.	No operation	Not stated	Death	
35	Berry-Albany Med. Ann., 1906, vol. 23, p. 773	Male	60	Not stated	Right	Not stated	Not stated	No	None	No operation	Not stated	Death	

CASES OF HYPERNEPHROMA. (Continued)

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result
36	Bierring and Albert-Jour. Am. Med. Ass., 1904, vol. 43, p. 234	Female	58	3 yrs.	Left	4 mos.	4 mos.	6 mos.	None	Nephrect.	None	Recovery	Not stated
37	Bierring and Albert-Jour. Am. Med. Ass., 1904, vol. 43, p. 234	Male	44	9 mos.	Left	9 mos.	Not stated	Not stated	None	No operation	Liver, lungs, and intestines	Death	
38	Bierring and Albert-Jour. Am. Med. Ass., 1904, vol. 43, p. 236.	Female	40	1 yr.	Right	Not stated	Yes	Not stated	None	Nephrect.	None	Recovery	2 mos. later, well
39	Bierring and Albert-Jour. Am. Med. Ass., 1904, vol. 43, p. 236	Female	25	1 yr.	Left	Yes	Not stated	Not stated	Edema lower extremities Ascites	No operation	Lungs and liver	Death	
40	Bierring and Albert-Jour. Am. Med. Ass., 1904, vol. 43, p. 236	Male	5	1 year	Right	Yes	Not stated	Not stated	"Softening of cervical glands"	No operation	Left ing. glands, liver, intestines, abd. cavity. (The tumor reproduced the medullary portion of the adrenal)	Death. Autop.	
41	Bland-Sutton Tumors, Innocent and Malignant, Lond., 1907, p. 113	Female	42	Not stated	Not stated	Yes	Not stated	Not stated	None	Nephrect.	None	Recovery	Well, 5 yrs. later. Delivered of child in interim

CASES OF HYPERNEPHROMA. (Continued)

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result
42	Böhler-Wien. klin. Woch., 1903, vol. 16, p. 549.	Male	51	6 mos.	Right	Not stated	Yes	5 mos.	None	No operation	Lungs, pleurae, left kidney, retroperitoneal glands, and ribs	Death. Autop.	
43	Böhler-Wien. klin. Woch., 1903, vol. 16, p. 553	Female	67	Few yrs.	Right	Yes	Not stated	Few yrs.	None	No operation	Lungs, right adrenal, left kidney	Death. Autop.	
44	Böhler-Wien. klin. Woch., 1903, vol. 16, p. 554	Male	63	1½ yrs.	Left	No	No	No	None (Lungs)	No operation	Lungs	Death. Autop.	
45	Böhler-Wien. klin. Woch., 1903, vol. 16, p. 554	Female	71	Not stated	Left	No	No	No	Pain in left leg	No operation	Lungs, liver, retroperitoneal glands, and ribs. Also left thigh (spontaneous fracture before death)	Death. Autop.	
46	Böhler-Wien. klin. Woch., 1903, vol. 16, p. 554	Male	50	5 mos.	Right	No	No	No	No kidney symptoms. Stiff neck. Weak extremities. Diagnosis of myelitis	No operation	Lungs and brain. Dorsal vertebrae with compression of cord.	Death. Autop.	
47	Bovée-Surg. Gyn. and Obst., 1906, vol. 3, p. 100	Female	53	5 yrs.	Right	5 yrs.	4 yrs.	Yes	None	Nephrect.	None	Recovery	Not stated

CASES OF HYPERNEPHROMA. (Continued)

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result
48	Bovée-Surg. Gyn. and Obst., 1906, vol. 3, p. 99	Female	38	6 mos.	Right	6 mos.	Not stated	Not stated	None	Nephrect. (A small calculus in pelvis)	None	Recovery	Not stated
49	Boyd and McFarland-Am. Jour. Med. Sci., 1902, vol. 123, p. 1069	Female	30	Unknown	Right	Yes	No	No	No kidney symptoms. Pregnant 6 mos. Pain over uterus	Incision. Drain	None	Death. Autopsy	
50	Brauniger-Beitr. z. klin. Chir., 1897, vol. 18, p. 497	Male	50	3 yrs.	Left	Yes	Not stated	3 yrs.	None	Nephrect.	None	Recovery	Well 4½ yrs. later
51	Brown-Ann. Surg., 1904, vol. 39, p. 299	Male	46	3 yrs.	Right	Yes	Yes	3 yrs.	X ray negative	Nephrect.	None	Recovery	Not stated
52	Brown-Ann. Surg., 1904 vol. 39, p. 300	Female	Adult	Unknown	Left	No	No	No	None	No operation	None	Death	
53	Brown-Ann. Surg., 1904, vol. 39, p. 300	Male	65	7 yrs.	Not stated	Not stated	Not stated	7 yrs.	None	Nephrect.	None	Recovery	Not stated
54	Burkhardt-Dtsch. Zeit. f. Chir., 1900, vol. 55, p. 97	Female	57	1 yr.	Right	Yes	1 yr.	Not stated	None	Nephrect.	None	Death (24 hrs.)	
55	Burkhardt-Dtsch. Zeit. f. Chir., 1900, vol. 55, p. 94	Male	40	Several mos.	Left	Yes	Not stated	Several mos.	None	Nephrect.	"Recurrences"	Recovery	Died 6 mos. later
56	Burkhardt-Dtsch. Zeit. f. Chir., 1900, vol. 55, p. 95	Male	50	Not stated	Left	Not stated	Yes	Yes	None	Nephrect.	Lungs	Death (4th day) Autopsy	

CASES OF HYPERNEPHROMA. (Continued)

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result
57	Burkhardt-Dtsch. Zeit. f. Chir., 1900, vol. 55, p. 91	Male	46	2 yrs.	Left	4 mos.	2 yrs.	4 mos.	None	Nephrect.	"Metastases"	Recovery	Died 6 mos. later. (metastases)
58	Chandler-N. Y. and Phila. Med. Jour., 1904, vol. 80, p. 451	Male	43	4 yrs.	Right	Yes	4 yrs.	4 yrs.	None	Nephrect.	None	Recovery	1 yr. later well
59	Cheeseman-Ann. Surg., 1907, vol. 45, p. 91	Male	1½	4 mos.	Right	Yes	No	No	Right varicocele	Nephrect. Tumor weighed 4½ lbs.	None	Recovery	Not stated
60	Clairmont-Archiv. f. klin. Chir., 1906, vol. 79, p. 686	Female	43	1 yr.	Right	1 yr.	Not stated	1 yr.	None	Nephrect.	None	Recovery	Not stated
61	Clairmont-Archiv. f. klin. Chir., 1906, vol. 79, p. 686	Female	47	3 mos.	Left	3 mos.	3 mos.	No	None	Nephrect.	None	Recovery	Well 5 mos. later
62	Clairmont-Archiv. f. klin. Chir., 1906, vol. 79, p. 686	Female	42	10 yrs.	Left	Yes	Not stated	Yes	None	Nephrect.	None	Recovery	Well 18 mos. later
63	Clairmont-Archiv. f. klin. Chir., 1906, vol. 79, p. 684	Male	54	3 mos.	Right	Yes	Yes	Yes	None	Nephrect.	"Recurrence of hematuria in 9 mos."	Recovery	Died 9 mos. later with recurrence of hematuria

CASES OF HYPERNEPHROMA. (Continued)

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result
64	Clairmont-Archiv. f. klin. Chir., 1906, vol. 79, p. 684	Male	54	1 yr. 9 mos.	Right	No	1 yr. 9 mos.	Yes	None	Nephrect.	"Embolus from tumor"	Death. Autopsy	
65	Clairmont-Archiv. f. klin. Chir., 1906, vol. 79, p. 684	Male	48	6 mos.	Right	Yes	Yes	No	None	Nephrect.	None	Recovery	Died 17 mos. later, pul. tuberculosis
66	Clairmont-Archiv. f. klin. Chir., 1906, vol. 79, p. 684	Male	59	4 yrs.	Left	Yes	4 yrs.	4 yrs.	None	Nephrect.	Not stated	Death	
67	Clairmont-Archiv. f. klin. Chir., 1906, vol. 79, p. 684	Male	42	4 mos.	Right	4 mos.	4 mos.	Yes	None	Nephrect.	None	Recovery	Not stated
68	Clairmont-Archiv. f. klin. Chir., 1906, vol. 79, p. 684	Female	39	3 yrs.	Right	3 yrs.	Not stated	No	None	Nephrect.	None	Recovery	3½ yrs. later, "fair health"
69	Clairmont-Archiv. f. klin. Chir., 1906, vol. 79, p. 684	Male	1 yr. 9 mos.	6 weeks	Right	Yes	Not stated	No	None	Nephrect. (horse-shoe kidney)	None	Death	
70	Clairmont-Archiv. f. klin. Chir., 1906, vol. 79, p. 684	Male	40	2 mos.	Right	Yes	No	Yes	None	Nephrect.	Not stated	Recovery	Died 2 yrs. later. Cause not stated

CASES OF HYPERNEPHROMA. (Continued)

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result
71	Clairmont-Archiv. f. klin. Chir., 1906, vol. 79, p. 684.	Female	58	2 mos.	Left	2 mos.	Not stated	No	None	Nephrect.	None	Recovery	Not stated
72	Clairmont-Archiv. f. klin. Chir., 1906, vol. 79, p. 684.	Female	27	2 yrs.	Left	2 yrs.	Not stated	No	None	Nephrect.	None	Recovery	Not stated
73	Clairmont-Archiv. f. klin. Chir., 1904, vol. 73, p. 620.	Male	39	Unknown	Right	Yes	Yes	Yes, first symptom	None	Nephrect. (diaphragm accidentally opened)	Peribronchial glands	Recovery	Died 10 yrs. later from recurrence in the peribronchial glands
74	Dorcett-St. Louis Med. Review, 1904, vol. 50, p. 385	Female	53	6 mos.	Not stated	6 mos.	Not stated	Not stated	None	Nephrect.	None	Recovery	Not stated
75	Driessen-Zeigler Beitr., 1893, vol. 12, p. 106	Male	79	Unknown	Not stated	Not stated	None	No	None	No operation	None	Died from other causes. Autopsy	
76	Driessen-Zeigler Beitr., 1893, vol. 12, p. 102	Female	34	6 yrs.	Right	6 yrs.	2 mos.	Not stated	None	Nephrect.	Not stated	Death, 12 hrs. Autopsy	
77	Eastwood-Tr. Path. Soc., Lond., 1902, vol. 53, p. 166	Male	50	5 mos.	Left	5 mos.	Not stated	No	None	Nephrect.	None	Death (few weeks)	
78	Eastwood-Tr. Path. Soc., Lond., 1902, vol. 53, p. 164	Female	35	Many mos.	Left	Many mos.	Yes	Yes	None	Nephrect.	"Recurrence in the skin"	Recovery	Died 1 yr. later from recurrence in skin

CASES OF HYPERNEPHROMA. (Continued)

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result
79	Fairbairn-Tr. Path. Soc. Lond., 1902, vol. 53, p. 184	Female	42	8 mos.	Left	8 mos.	6 mos.	Not stated	None	Nephrect.	None	Recovery	Not stated
80	Garceau-Am. Jour. Urol., 1906, vol. 2, p. 246	Female	29	6 mos.	Left	6 mos.	6 mos.	No	None. X-ray positive	Nephrect.	Ureter same side to pelvic brim	Recovery	Well 3 yrs. later. (In spite of fact that portions of tumor around the large vessels were not removed)
81	Gatti-Virch. Archiv., 1896, vol. 144, p. 468	Female	62	2 yrs. (blow 8 yrs. previously)	Right	2 yrs.	2 yrs.	2 yrs.	None	Nephrect.	None	Recovery	Not stated
82	Gohn-Wien. klin. Woch., 1904, vol. 17, p. 1391	Female	Adult	7 mos.	Left	No	No	No	None	Operation on clavicle	Clavicle, lungs, right adrenal	Recovery from operation on clavicle	Died in 10½ mos.
83	Grawitz-Virch. Archiv., 1883, vol. 93, p. 50	Not stated	Adult	5 yrs.	Left	2 yrs.	No	5 yrs.	None. Papillary masses in the urine	No operation	None	Death (peritonitis)	
84	Hardon-Ill. Med. Jour., 1903-04, vol. 5, p. 909	Female	60	2 yrs.	Right	2 yrs	Yes	Not stated	X-ray positive	Nephrect.	None	Recovery	3 mos. later, well
85	Hildebrand-Archiv. f. klin. Chir., 1894, vol. 47, p. 234	Female	49	6 mos.	Left	6 mos.	Not stated	No	None	Nephrect.	Lungs	Recovery	Died 6 mos. later from lung metastasis

CASES OF HYPERNEPHROMA. (Continued)

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result
86	Hildebrand-Archiv. f. klin. Chir., 1894, vol. 47, p. 232	Female	39	8 mos.	Right	Yes	Not stated	8 mos.	None	Nephrect.	None	Recovery	1 yr. later, well
87	Hildebrand-Archiv. f. klin. Chir., 1894, vol. 47, p. 226	Male	47	8 yrs.	Right	Few days	Not stated	8 yrs.	None	Nephrect.	Both inguinal glands	Death(½ hr.)	
88	Hildebrand-Archiv. f. klin. Chir., 1894, vol. 47, p. 232	Female	39	8 mos.	Right	Yes	Not stated	8 mos.	None	Nephrect.	None	Recovery	Not stated
89	Hildebrand-Archiv. f. klin. Chir., 1894, vol. 47, p. 232	Female	49	6 mos.	Not stated	6 mos.	Not stated	No	None	Nephrect.	None	Recovery	Not stated
90	Hoffman-Dtsch. Med. Woch., 1907, vol. 33, p. 303	Male	56	2 yrs.	Left	Yes	2 yrs.	No	Paralysis left arm. Spontaneous fracture of right thigh	No operation	Brain, ribs, legs, thigh, spleen	Death. Autopsy	
91	Hoffman-Dtsch. Med. Woch., 1907, vol. 33, p. 303	Female	60	6 mos.	Left	6 mos.	Not stated	No	Cystitis	No operation	Lungs, pelvis, bladder wall, bronchial glands, tibia	Death. Autopsy	
92	Hubbard-Boston Med. and Surg. Jour., 1906, vol. 154, p. 339	Male	56	2 yrs.	Right	Yes	Yes	2 yrs.	None	Nephrect.	None	Recovery	Not stated

CASES OF HYPERNEPHROMA. (Continued)

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result
93	Huntly-Lancet, Lond., 1906, vol. 2, p. 862	Female	68	Not stated	Right	Yes	No	Yes	None	Nephrect.	None	Recovery	Not stated
94	Illyes-Pest. Med. Chir. Presse, Budapest, 1907, vol. 43, p. 63	Male	47	2 mos.	Right	Yes	Not stated	2 mos.	None	Nephrect.	None	Recovery	Not stated
95	Israel-Chir. Klinik d. Nierenkrankheiten, Berlin, 1901, p. 494	Female	43	4 mos.	Left	Yes	4 mos.	No	None	Nephrect.	None	Recovery	Well, 9 yrs. 7 mos. later
96	Israel-Chir. Klinik d. Nierenkrankheiten, Berlin, 1901, p. 495	Male	61	1 yr.	Left	1 yr.	Not stated	1 yr.	None	Nephrect.	None	Recovery	Well 5 yrs. 5 mos. later
97	Israel-Chir. Klinik d. Nierenkrankheiten, Berlin, 1901, p. 496	Male	58	5 yrs.	Left	Yes	Not stated	5 yrs.	None	Nephrect.	None	Recovery	2 yrs. 3 mos. later, recurrence in supra-clavicular glands
98	Israel-Chir. Klinik d. Nierenkrankheiten, Berlin, 1901, p. 497	Female	52	15 mos.	Left	Yes	15 mos.	11 mos.	None	Nephrect.	Peritoneum, pleurae	Recovery	Died 6 mos. later from metastases
99	Israel-Chir. Klin. d. Nierenkrankheiten, Berlin, 1901, p. 497	Male	52	2 yrs.	Left	Yes	Yes	Yes	None	Nephrect.	None	Recovery	Died soon after from cardiac affection

CASES OF HYPERNEPHROMA. (Continued)

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result
107	Israel-Chir. klin. d. Nierenkrankheiten, Berlin, 1901, p. 510	Male	59	6 mos.	Left	Yes	Yes	6 mos.	None	Nephrect.	None	Recovery	Not stated
108	Israel-Chir. klin. d. Nierenkrankheiten, Berlin, 1901, p. 511	Male	56	10 yrs.	Right	Yes	Yes	10 yrs.	None	Nephrect.	None	Recovery	Recent case
109	Israel-Chir. klin. d. Nierenkrankheiten, Berlin, 1901, p. 512	Male	48	6 mos.	Right	Yes	Not stated	6 mos.	None	Nephrect.	None	Recovery	Not stated
110	Israel-Chir. klin. d. Nierenkrankheiten, Berlin, 1901, p. 512	Male	52	Unknown	Not stated	3 mos.	No	No	None	Nephrect.	Lungs	Recovery	3 mos. later died from met. to lungs
111	Israel-Chir. klin. d. Nierenkrankheiten; Berlin, 1901, p. 513	Male	64	6 yrs.	Right	Yes	6 yrs.	No	None	Nephrect.	Lungs, right thorax, ilium, liver, and bronchial glands	Recovery	Died 2 yrs. later from metastases
112	Israel-Chir. klin. d. Nierenkrankheiten, Berlin, 1901, p. 308	Male	42	3 mos.	Right	Not stated	Yes	3 mos.	None	Nephrect.	None	Recovery	Not stated
113	Jellinek-Pacific Med. Jour., 1903, vol. 46, p. 748	Male	55	Not stated	Right	Yes	Yes	Yes	None	Nephrect.	None	Recovery	Not stated

CASES OF HYPERNEPHROMA. (Continued)

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result
100	Israel-Chir. klin. d. Nierenkrankheiten., Berlin, 1901, p. 500	Male	67	8 mos.	Right	8 mos.	Not stated	8 mos.	None	Nephrect.	Recurrence in scar	Recovery	1 yr. 5 mos. later, recurred in scar, excised. Well 1 yr. 5 mos. later
101	Israel-Chir. klin. d. Nierenkrankheiten, Berlin, 1901, p. 501	Male	26	4 mos.	Left	4 mos.	Not stated	4 mos.	None	Nephrect.	"Recurrences"	Recovery	Died 1½ yrs. later from recurrence
102	Israel-Chir. klin. d. Nierenkrankheiten, Berlin, 1901, p. 502	Male	Adult	2 yrs.	Right	Yes	Not stated	2 yrs.	None	Nephrect.	None	Death. Autopsy	
103	Israel-Chir. klin. d. Nierenkrankheiten, Berlin, 1901, p. 504	Female	57	6 mos.	Right	No	No	6 mos.	None	Nephrect.	Brains, lungs, spleen	Recovery	Died, 1½ yrs. later from met. to brain
104	Israel-Chir. klin. d. Nierenkrankheiten, Berlin, 1901, p. 506	Male	46	1 yr. 9 mos.	Left	Yes	Not stated	1 yr. 9 mos.	None	Nephrect.	None	Death (11 days)	
105	Israel-Chir. klin. d. Nierenkrankheiten, Berlin, 1901, p. 507	Female	58	5 mos.	Right	Yes	Not stated	5 mos.	None	Nephrect.	None	Recovery	Well 5 yrs. 10 mos. later
106	Israel-Chir. klin. d. Nierenkrankheiten, Berlin, 1901, p. 508	Male	55	12 yrs.	Left	Yes	Not stated	12 yrs.	None	Nephrect.	None	Death (3 days)	

CASES OF HYPERNEPHROMA. (Continued)

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result
114	Jellinek-Cal. State Med. Jour., 1904, vol. 2, p. 54	Male	Adult	5 yrs.	Right	Yes	Yes	Yes	None	Nephrect.	Spinal column	Recovery	Died a few mos. later from met.
115	Jellinek-Cal. State Med. Jour., 1904, vol. 2, p. 55	Male	55	1 yr.	Right	Yes	Not stated	1 yr.	Chills, fever, sweats	Nephrect.	None	Recovery	Well a few mos. later
116	Keen, Pfahler and Ellis-Am. Med., 1904, vol. 8, p. 1040	Female	54	2 yrs.	Right	Yes	Yes	No	Onset with gastro-intestinal sympt. X-ray gave shadows	Nephrect.	None	Recovery	Well 1 yr. later
117	Keen, Pfahler and Ellis-Am. Med., 1904, vol. 8, p. 1039	Male	52	3 yrs.	Right	2 yrs.	Yes	3 yrs.	None	Nephrect.	None	Recovery	Well, 4 yrs. later
118	Kusmik-Beitr. z. klin. Chir., 1905, vol. 45, p. 186	Male	57	Not stated	Left	Yes	Not stated	Yes	None	Nephrect.	None	Recovery	Not stated
119	Kusmik-Beitr. z. klin. Chir., 1905, vol. 45, p. 188	Female	54	11 mos.	Right	Yes	No	11 mos.	None	Nephrect.	None	Recovery	Died 1 yr. 4 mos. later with uremic symptoms
120	Kusmik-Beitr. z. klin. Chir., 1905, vol. 45, p. 191	Mal	56	3 yrs.	Left	3 yrs.	2 mos.	No	None	Nephrect.	Ribs, lumbar vertebrae, pleurae, vena cava	Death (26 days)	
121	Le Count-Tr. Path. Soc., Chi., 1903-04, vol. 6, p. 373	Male	57	Not stated	Right	Yes	Not stated	Not stated	None	No operation on kidney	Jaw, 2 operations	Death. Autopsy	

CASES OF HYPERNEPHROMA. (Continued)

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result
122	Le Count-Tr. Path. Soc., Chi., 1901-03, vol. 5, p. 67	Female	40	5 mos.	Left	5 mos.	No	No	None	Exploratory	Omentum, uterus, spleen, and myocardium	Recovery	Died a few mos. later from met.
123	Le Count-Tr. Path. Soc., Chi., 1901-03, vol. 5, p. 82	Male	Adult	3 mos.	Right	No	No	No	None	No operation	Right thigh (spont.fract.), sacral vert. and left inguinal gl.	Died 1 yr. after first symptom. Autopsy	
124	Lillienthal-Am. Jour. Dermat. and Gen. Urin. Dis., St. Louis, 1904, vol. 8, p. 160	Female	28	4 weeks	Not stated	Yes	Not stated	4 weeks	None	Nephrect.	None	Recovery	Not stated
125	Lillienthal-Ann. Surg., 1904, vol. 39, p. 300	Female	Adult	Not stated	Not stated	Not stated	Not stated	Not stated	None	Nephrect.	Frontal bone	Recovery	1 year after operation had met. in front. region commun. with brain
126	Lillienthal-Ann. Surg., 1904, vol. 39, p. 300	Male	Adult	Not stated	Not stated	Not stated	Not stated	Not stated	None	Nephrect.	"Prompt recurrence"	Recovery	Died soon afterwards
127	Lotheisen-Archiv. f. klin. Chir., 1896, vol. 52, p. 734	Female	56	Not stated	Left	Yes	Not stated	Not stated	None	Nephrect.	Local recurrence	Recovery	Died 6 mos. later from recurrence
128	Lotheisen-Archiv. f. klin. Chir., 1896, vol. 52, p. 734	Male	20	Not stated	Right	Yes	Not stated	Not stated	None	Nephrect.	None	Recovery	Well 2½ yrs. later

CASES OF HYPERNEPHROMA. (Continued)

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result
129	Lowenhardt-Dtsch. Zeit. f. Chir., 1888, vol. 28, p. 583	Male	46	5 yrs.	Right	No	No	No	None	No operation on kidney	Left ster.-Clav. joint, and neck. Chest		Died 5 yrs. after first symptoms. Autop. Hypern. rt. kidney
130	Lubarsch-Virch. Archiv., 1894, vol. 135, p. 149	Male	52	7 mos.	Right	Yes	Not stated	7 mos.	None	Nephrect.	None	Death (immediate)	
131	Lubarsch-Virch. Archiv., 1894, vol. 135, p. 167	Female	64	1 yr.	Right	Not stated	1 yr.	6 weeks	None	Nephrect.	None	Death (few days later)	
132	Lubarsch-Virch. Archiv., 1894, vol. 135, p. 170	Male	73	7 mos.	Right	7 mos.	Not stated	Not stated	None	No operation on kidney	Lungs		Died 7 mos. after first symptoms.
133	Lubarsch-Virch. Archiv., 1894, vol. 135, p. 176	Male	50	7 yrs.	Left	Yes	Yes	3 yrs.	None	Nephrect.	None	Death (4 days)	
134	Mayo (Herb)-Amer. Jour. Med. Sci., 1905, vol. 129, p. 1010	Female	45	2 yrs.	Left	2 yrs.	4 mos.	Not stated	None	Nephrect.	None	Recovery	Well 2½ yrs. later
135	Mayo (Herb)-Amer. Jour. Med. Sci., 1905, vol. 129, p. 1010	Female	64	Not stated	Not stated	Yes	Yes	Yes	None	Nephrect.	None	Recovery	Not stated
136	Mayo (Herb)-Amer. Jour. Med. Sci., 1905, vol. 129, p. 1011	Female	61	4 yrs.	Right	Yes	Yes	10 years	None	Nephrect.	None	Recovery	Not stated

CASES OF HYPERNEPHROMA. (Continued)

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immedate Result	End Result
137	McWeeney-Brit. Med. Jour., 1896, vol. 1, p. 323	Female	53	9 mos.	Left	Yes	Yes	No	None	Nephrect.	None	Recovery	Not stated
138	McWeeney-Brit. Med. Jour., 1896, vol. 1, p. 323	Female	38	6 mos.	Left	Yes	6 mos.	No	None	Nephrect.	None	Death (9 hrs.)	
139	Noble-Amer. Gyn., 1902, vol. 1, p. 69	Female	24	Not stated	Right	Yes	Not stated	Not stated	None	Nephrect.	Not stated	Recovery	Well a few mos. later
140	Ohlmacher-Trans. Chi. Path. Soc., 1901-1903, vol. 5, p. 85,	Female	49	5 yrs.	Not stated	6 mos.	5 yrs.	5 yrs.	None	Nephrect.	Left temporal bone, neck, left axilla, right abd. wall	Recovery	Died 2 mos. after operation from met.
141	Ohlmacher-Cleveland Med. Jour., 1903, vol. 2, p. 120	Male	52	2 yrs.	Left	Yes	Not stated	2 yrs.	None	No operation	Not stated	Death	
142	Perthes-Dtsch. Zeit. f. Chir., 1895, vol. 42, p. 227	Male	56	Two years	Right	Not stated	Two years	Two years	None	Nephrect.	Liver	Death (few days)	
143	Perthes-Dtsch. Zeit. f. Chir., 1895, vol. 42, p. 224	Female	46	Five years	Right	Five years	Not stated	Five years	None	Nephrect.	Mediastinum, pleura, lungs, heart and liver	Recovery	Died 6 mos. later, from metastases
144	Perthes-Dtsch. Zeit. f. Chir., 1895, vol. 42, p. 223	Male	50	One year	Right	Yes	Yes	One year	None	Nephrect.	In the scar.	Recovery	Death one year after operation from metastases

CASES OF HYPERNEPHROMA. (Continued)

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result
129	Lowenhardt-Dtsch. Zeit. f. Chir., 1888, vol. 28, p. 583	Male	46	5 yrs.	Right	No	No	No	None	No operation on kidney	Left ster.-Clav. joint, and neck. Chest		Died 5 yrs. after first symptoms. Autop. Hypern. rt. kidney
130	Lubarsch-Virch. Archiv., 1894, vol. 135, p. 149	Male	52	7 mos.	Right	Yes	Not stated	7 mos.	None	Nephrect.	None	Death (immediate)	
131	Lubarsch-Virch. Archiv., 1894, vol. 135, p. 167	Female	64	1 yr.	Right	Not stated	1 yr.	6 weeks	None	Nephrect.	None	Death (few days later)	
132	Lubarsch-Virch. Archiv., 1894, vol. 135, p. 170	Male	73	7 mos.	Right	7 mos.	Not stated	Not stated	None	No operation on kidney	Lungs		Died 7 mos. after first symptoms.
133	Lubarsch-Virch. Archiv., 1894, vol. 135, p. 176	Male	50	7 yrs.	Left	Yes	Yes	3 yrs.	None	Nephrect.	None	Death(4 days)	
134	Mayo (Herb)-Amer. Jour. Med. Sci., 1905, vol. 129, p. 1010	Female	45	2 yrs.	Left	2 yrs.	4 mos.	Not stated	None	Nephrect.	None	Recovery	Well 2½ yrs. later
135	Mayo (Herb)-Amer. Jour. Med. Sci., 1905, vol. 129, p. 1010	Female	64	Not stated	Not stated	Yes	Yes	Yes	None	Nephrect.	None	Recovery	Not stated
136	Mayo (Herb)-Amer. Jour. Med. Sci., 1905, vol. 129, p. 1011	Female	61	4 yrs.	Right	Yes	Yes	10 years	None	Nephrect.	None	Recovery	Not stated

CASES OF HYPERNEPHROMA. (Continued)

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immedate Result	End Result
137	McWeeney-Brit. Med. Jour., 1896, vol. 1, p. 323	Female	53	9 mos.	Left	Yes	Yes	No	None	Nephrect.	None	Recovery	Not stated
138	McWeeney-Brit. Med. Jour., 1896, vol. 1, p. 323	Female	38	6 mos.	Left	Yes	6 mos.	No	None	Nephrect.	None	Death (9 hrs.)	
139	Noble-Amer. Gyn., 1902, vol. 1, p. 69	Female	24	Not stated	Right	Yes	Not stated	Not stated	None	Nephrect.	Not stated	Recovery	Well a few mos. later
140	Ohlmacher-Trans. Chi. Path. Soc., 1901-1903, vol. 5, p. 85,	Female	49	5 yrs.	Not stated	6 mos.	5 yrs.	5 yrs.	None	Nephrect.	Left temporal bone, neck, left axilla, right abd. wall	Recovery	Died 2 mos. after operation from met.
141	Ohlmacher-Cleveland Med. Jour., 1903, vol. 2, p. 120	Male	52	2 yrs.	Left	Yes	Not stated	2 yrs.	None	No operation	Not stated	Death	
142	Perthes-Dtsch. Zeit. f. Chir., 1895, vol. 42, p. 227	Male	56	Two years	Right	Not stated	Two years	Two years	None	Nephrect.	Liver	Death (few days)	
143	Perthes-Dtsch. Zeit. f. Chir., 1895, vol. 42, p. 224	Female	46	Five years	Right	Five years	Not stated	Five years	None	Nephrect.	Mediastinum, pleura, lungs, heart and liver	Recovery	Died 6 mos. later, from metastases
144	Perthes-Dtsch. Zeit. f. Chir., 1895, vol. 42, p. 223	Male	50	One year	Right	Yes	Yes	One year	None	Nephrect.	In the scar.	Recovery	Death one year after operation from metastases

CASES OF HYPERNEPHROMA. (Continued)

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result
145	Peuckert-Am. Jour. Urol., 1905, vol. 2, p. 124	Female	41	6 mos.	Right	6 wks.	6 wks.	3 mos.	None	Nephrect.	Left hip, thigh, knee, gluteal region	Recovery	Died 3 yrs. and 9 mos. after operation from metastases
146	Peuckert-Am. Jour. Urol., 1905, vol. 2, p. 120	Male	48	One year	Right	No	1 yr.	One year	None	Nephrect.	None	Recovery	Well two years later
147	Peuckert-Am. Jour. Urol., 1905, vol. 2, p. 116	Male	50	4 mos.	Right	No	3 mos.	4 mos.	None	Nephrect.	None	Recovery	Well two years later
148	Pinner-Arch. f. klin. Chir., 1898, vol. 56, p. 500	Male	35	Seven years	Right	No	Seven years	2 days	None	Nephrect.	Local recurrence and thrombosis in vena cava reaching to right auricle-retroperitoneal glands	Recovery	Died two mos. after operation from metastases
149	Pirone-Arch. d. Méd. Exper. et. d'Anat. Path., 1903, vol. 15, p. 219	Male	40	Few months	Left	Few mos.	Few mos.	Few mos.	None	Nephrect.	Not stated	Recovery	Not stated
150	Richards-Guy's Hosp. Reports, 1905, vol. 59, p. 331	Male	59	2 years	Left		2 years	One year	None	Nephrect.	None	Recovery	Not stated
151	Richards-Guy's Hosp. Reports, 1905, vol. 59, p. 331	Male	68	Not stated	Left	stated	Yes	Yes	None	No operation	Not stated	Death (next day)	

CASES OF HYPERNEPHROMA. (Continued)

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result
152	Richards-Guy's Hosp. Reports, 1905, vol. 59, p. 324	Male	58	"Kick in the left loin at 13 yrs. of age. Immediate symptoms 6 yrs."	Left	Yes	2 yrs.	6 yrs.	None	Nephrect.	Not stated	Death (11 days)	
153	Richards-Guy's Hosp. Reports, 1905, vol. 59, p. 331	Male	68	Not stated	Left	Not stated	Not stated	Yes	None	No operation on kidney	Not stated	Death (immediate)	
154	Richards-Guy's Hosp. Reports, 1905, vol. 59, p. 331	Male	59	2 yrs.	Not stated	2 yrs.	Not stated	No	None	Nephrect.	None	Recovery	Not stated
155	Rupprecht-Centr. f. Gynäk., 1890, vol. 14, p. 592	Not stated	24	Not stated	Right	Yes	Not stated	No	None	Nephrect.	None	Recovery	Well 1 yr. later
156	Sanford-Yale Med. Jour., 1902-1903, vol. 9, p. 274	Male	47	2 yrs.	Right	Yes	Yes	2 yrs.	Fever	Nephrect.	None	Recovery	Not stated
157	Schultz-Med. News, 1904, vol. 85, p. 98	Male	52	Not stated	Right	Yes	Not stated	Not stated	None	No operation on kidney	Lower end right femur, lungs, bronchi.	Death	
158	Scudder-Ann. Surg., 1906, vol. 44, p. 859	Female	41	Not stated	Left	Yes	Not stated	Not stated	None	Nephrect.	Not stated	Death (5 days)	
159	Scudder-Annals of Surg., 1906, vol. 44, p. 860	Female	40	Not stated	Left	Not stated	Yes	Not stated	None	Nephrect.	Not stated	Recovery	Died in a few months

CASES OF HYPERNEPHROMA. (Continued)

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result
160	Scudder-Annals of Surg., 1906, vol. 44, p. 861	Female	58	Not stated	Right	Yes	Not stated	Not stated	None	Nephrect.	Not stated	Recovery	Died two mos. later
161	Scudder-Annals of Surg., 1906, vol. 44, p. 862	Not stated	Not stated		Right	Yes	Yes	No	None	Nephrect.	Liver	Recovery	Died one year later from metastases
162	Scudder-Annals of Surgery, 1906, vol. 44, p. 864	Male	65	Several years	Left	Yes	Not stated	Not stated	Varicocele	No operation on kidney	Not stated	Death	
163	Scudder-Annals of Surg. 1906, vol. 44, p. 856	Male	49	Several mos.	Not stated	Not stated	Yes	Several mos.	None	Nephrect.	In the scar	Recovery	One year later recurrence in scar
164	Shattuck and Harrington-Bos. Med. and Surg. Jour., 1906, v. 154, p. 270	Male	39	Not stated	Not stated	8 mos.	8 mos.	No	None	Nephrect.	Glands of axilla and groins. Ureter affected as low as pelvic brim	Recovery	Not stated
165	Shepherd and Gillis-Mont. Med. Jour., 1905, vol. 34, p. 546	Male	61	Few mos.	Left	Yes	Yes	No	None	Nephrect.	None	Recovery	Three mos. later well
166	Taylor-Am. Jour. Med. Sci., 1906, vol. 131, p. 210	Male	44	1 yr.	Not stated	Yes	Yes	No	None	Nephrect.	Recurrence at site of operation	Recovery	Died 8 mos. after operation from metastases

CASES OF HYPERNEPHROMA. (Continued)

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result
167	Thompson-Trans. Southern Surg.and Gyn. Ass., 1902, vol. 15, p. 327	Female	55	3 yrs.	Right	3 yrs.	Yes	Not stated	Paralysis lower and upper extremities (deposit in spine)	Nephrect.	Probably the spine	Death (soon after)	
168	Thompson-Trans. South. Surg.and Gyn. Ass., 1902, vol. 15, p. 324	Male	68	Not stated	Right	Yes	Yes	Not stated	None	Nephrect.	Not stated	Death (at once)	
169	Thompson-Trans. South. Surg.and Gyn. Ass., 1902, vol. 15, p. 322	Male	63	2 mos.	Left	2 mos.	2 mos.	No	None	Nephrect.	Not stated	Recovery	Not stated
170	Th'rndike and Cunningham-Bos. Med. and Surg. Jour., 1903, vol. 149, p. 613	Male	52	4 mos.	Not stated	No	4 mos.	4 mos.	None	Nephrect.	Not stated	Death (at once)	
171	Th'rndike and Cunningham-Bos. Med.and Surg. Jour., 1903, vol. 149, p. 612	Female	52	Few months	Right	Yes	Yes	Few mos.	None	Nephrect.	None	Recovery	Not stated
172	Th'rndike and Cunningham-Bos. Med.and Surg. Jour., 1903, vol. 149, p. 611	Male	48	8 yrs.	Right	1 week	8 yrs.	3 yrs.	None	Nephrect.	None	Recovery	Well 9 mos. later. Gained 40 pounds

CASES OF HYPERNEPHROMA. (Continued)

No.	Name and Reference	Sex	Age	Duration	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result
173	Wainwright-Tr. Lackawanna Co. Med. Soc., Scranton, 1905, vol. 1., p. 137	Male	22	5 mos.	Right	5 mos.	5 mos.	Not stated	None	Nephrotomy	Not stated	Death (7 days)	
174	Watson-Ann. Surg., 1904, vol. 40, p. 1005	Female	52	4 mos.	Right	4 mos.	Not stated	Not stated	First symptoms were irrit. bladder and gastric disturbances	Nephrectomy	Not stated	Recovery	Died 14 mos. later from "cerebral embolism"
175	Wells-Trans. Chicago Path. Soc., 1903-1906, vol. 6, p. 375	Male	63	6 mos.	Left	No	Yes	No	First symptom was sharp pain and sudden paralysis which persisted until death	No operation on kidney	Retroperitoneal and mediastinal lymph glands 5th and 9th dorsal vertebrae	Death (autopsy)	
176	Wendell-Arch. f. klin. Chir., 1904, vol. 73, p. 991	Male	35	5 weeks	Left	Yes	5 wks.	No	None	Nephrect.	Right kidney	Death (autopsy) (40 hours)	

Carcinoma, Sarcoma and Malignant Adenoma

Etiology

Well authenticated cases of renal carcinoma, sarcoma and malignant adenoma are so few that it is impossible to give many data in regard to their etiology.

These tumors are most common between the ages of forty and seventy, at a time when malignant disease usually manifests itself.

Kelynack's[1] figures were taken from the pathologic records of 4505 cases of death from all causes; among these he found nine cases or .19 per cent. of primary renal growths. The proportion of the above tumors is, therefore, considerably less than this. Reiche[2] found among 11,930 cases of malignant disease affecting various parts of the body, eighty primary malignant growths of the kidney, a proportion of .7 per cent.

With regard to the comparative frequency of secondary deposits of malignant growths in the kidney, Kelynack's[3] figures are interesting. He analyzed one hundred and ninety-five cases of malignant tumors affecting the various organs in the body, of which one hundred and twenty-six were carcinomata, and sixty-nine sarcomata; of the one hundred and twenty-six carcinomata there were only seven which had secondary deposits in the kidney, and of the sarcomata there were ten which had a similar extension.

Pathology of Carcinoma

Our knowledge of carcinoma of the kidney is very limited because not only is the disease exceedingly rare, but few cases being found in any hospital, but also because it is only within the past few years that these growths have been definitely separated from other forms of renal tumor. Reports

[1]Renal Growths, London, 1898, p. 19.
[2]Dtsch. Med. Woch., 1900, Vol. 26, p. 121.
[3]Renal Growths, London, 1898, p. 21.

of cases of this disease are very incomplete, and this is particularly true with regard to the pathology.

The list compiled by the writer of renal tumors occurring during the past ten years at the Massachusetts General Hospital and the Boston City Hospital is as follows:

Large hypernephromata	33
Carcinomata	3
Large sarcomata	2
Large papillary adenomata	4
Total	42

Expressed in percentages this gives 78 per cent. for the hypernephromata, 7 per cent. for the carcinomata, 4 per cent. for the sarcomata, and 9 per cent. for the papillary adenomata.

There were a few other tumors, especially small papillary adenomata, of very small size which were accidental pathologic findings and had no clinical interest.

It is apparent that these figures are distinctly at variance with figures given by other authors. In Albarran and Imbert's list[1] there are 380 tumors. These cases were compiled from various sources, and although it is stated that a histologic examination had been made, yet the authors themselves say that owing to the confused state of the pathology it is certain that there must have been great confusion in naming the growths. Albarran and Imbert themselves admit that the table has no real value. A careful perusal of their book reveals the fact that these authors are very much in doubt as to the proper significance and classification of many of the tumors which they discuss. They describe an "epithelioma with clear transparent cells," likewise an "adenoma with clear transparent cells"; the former they think is malignant, the latter benign. They believe furthermore that these two tumors may originate both in the renal epithelium and in suprarenal "rests." The description,

[1]Loc. cit. p. 16.

given by the authors, of these two tumors corresponds in every particular to the type generally recognized as hypernephroma. These authors have also confused "angiosarcoma" and "endothelioma," and in speaking of their pathogenesis they intimate that these tumors are allied "in part to epithelioma with clear transparent cells and in part to tumors taking origin from suprarenal 'rests.'"

Kelynack is also far from clear. His table of 306 tumors he admits may be far from correct, and intimates that the "angiosarcoma" may have many times been mistaken for hypernephroma.

Morris is inclined to believe that the "pure renal cancer" is very frequent, and he intimates that it must be more common than the adrenal "rest" tumor, but a careful reading of his book finds no convincing figures. He contents himself with merely intimating his belief.

The table given by the writer is made up of cases in which an autopsy had been made and the gross and microscopic appearances of the tumors carefully recorded. The tumors classified as "hypernephromata" all agreed with the description now generally admitted to be typical of this growth. In order to make evident the differences between hypernephroma and the other four malignant renal tumors full quotations from the pathologic records at the two hospitals will be given in the section on symptomatology, and it will be readily seen how great the differences are in their minute structure as compared with hypernephroma.

Carcinoma of the kidney results from the proliferation of the renal tubules, as was first definitely shown by Waldeyer[1].

One of the most characteristic features of carcinoma is the grouping of the cancer cells in masses without any definite arrangement. The cells infiltrate the tissues, crowding into them, and growing in among the normal cells. The interstitial tissue, the tubules, and the glomeruli, are thus in-

[1]Virch. Arch., Vol. 41, p. 493.

Fig. 9.—Carcinoma of the Renal Parenchyma, showing arrangement of Cancer Cells in masses; also the infiltrating form. The tissues are diffusely infiltrated, especially the glomeruli. (X25.)
From the Path. Lab'y at the Boston City Hospital. No. SO4.768.

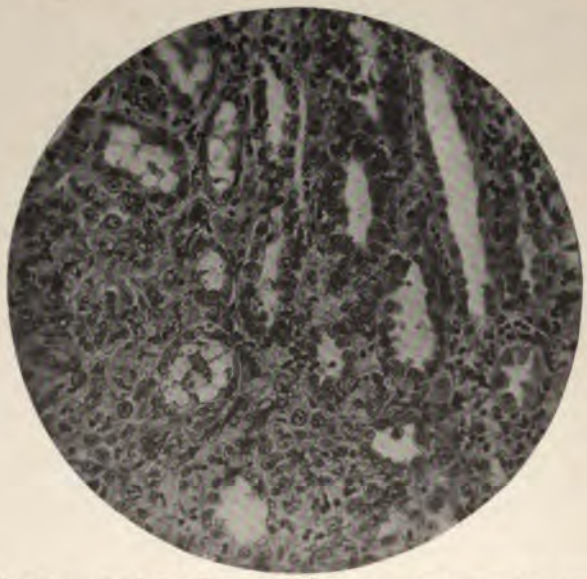

Fig. 10.—Carcinoma of the Renal Parenchyma, showing the arrangement of the Cancer Cells in columns, and also in masses (X190.)
From the Lab'y at the Boston City Hospital. No. SO5.901.

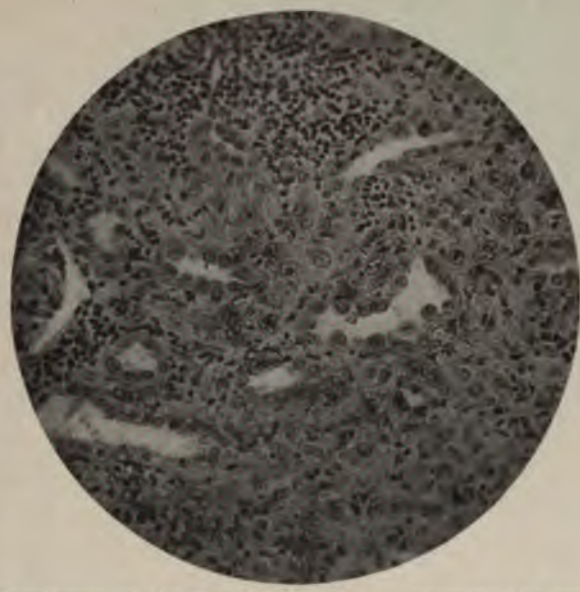

Fig. 11.—Carcinoma of the Renal Parenchyma, showing the arrangement of the Cancer Cells in columns and masses (X190).
From the Path. Lab'y, at the Boston City Hospital. No. S05.901.

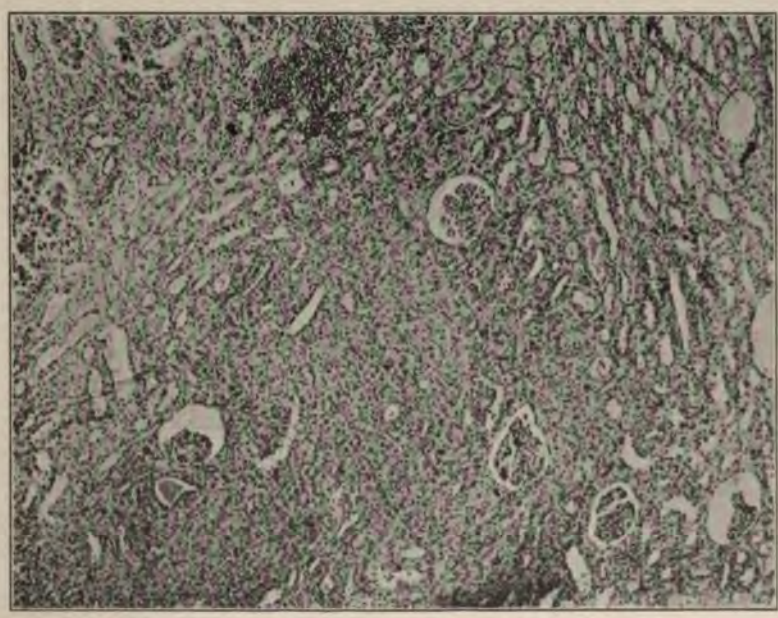

Fig. 12.—Carcinoma of the Renal Parenchyma, showing arrangement of the Cancer Cells in masses (X25).
From the Path. Lab'y at the Boston City Hospital. No. S05.901.

vaded (Fig. 9). In parts also the cancer cells are arranged in columns and cords of regularly disposed columnar epithelium, presenting on section a striking resemblance to the tubular arrangement of the normal kidney (Fig. 10); in other places the cells are arranged in masses without any definite form and they enter into the surrounding renal tissue (Figs. 11 and 12).

Another distinctive feature of carcinoma is the arrangement of the cells in alveoli, large and small, which are surrounded by a stroma of connective tissue (Fig. 13). The cells are arranged close together, one against the other (Fig. 14).

A peculiarity which has not been often mentioned in monographs on the pathology of malignant renal tumors is the coexistence of markedly dissimilar structures in the same specimen; or, what is still more striking, the structure of the tumor may recall all the features of renal carcinoma, yet the metastases of the growth may answer in every way to the well known type of hypernephroma. The notes of such a case are to be found in the pathologic records (UO5.7 and So4.768) in the Boston City Hospital, and the microscopic slides are likewise preserved. In this case the growth in the kidney (Fig. 9) illustrated general infiltration of the cancer cells; the glomeruli were invaded by them, and likewise the tubules. There was no arrangement which suggested hypernephroma; yet the metastases in the liver (Fig. 15) recalled in every way metastases from a typical hypernephroma of the kidney What the relation is between these two dissimilar structures the writer does not venture to say. The gross appearance of this tumor is shown in Fig. 16.

Carcinoma of the kidney does not usually reach a very large size, the malignant character of the disease usually bringing a fatal ending before the growth has had an opportunity to increase very much in size. The shape of the kidney is not usually greatly distorted, as the cancerous growth infiltrates the organ quite evenly and causes a uniform enlargement.

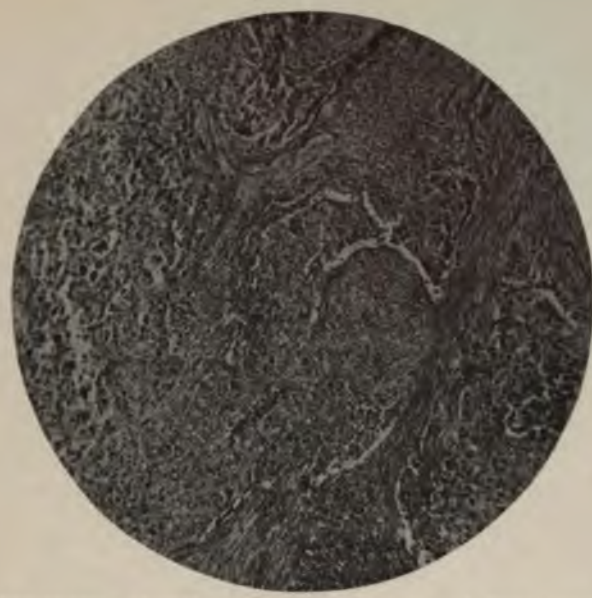

Fig. 13.—Carcinoma, showing a typical collection of Cancerous Alveoli; showing also the formation in masses.
From a specimen loaned by Dr. E. H. Nichols, Boston, Mass.

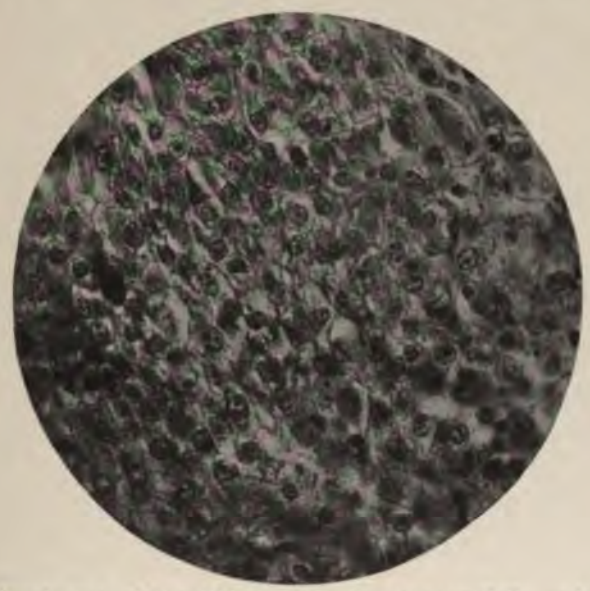

Fig. 14.—Carcinoma of the Kidney, showing Cancer Cells under magnification (X375).
From the Lab'y at the Boston City Hospital. No. S05.901.

Fig. 15.—Metastasis in the Liver of Carcinoma of the Kidney. The Kidney Tumor showed Typical Cancerous Alveoli, but the Metastasis is of the Hypernephroma Type (X190).
From the Lab'y at the Boston City Hospital. No. S04.768.

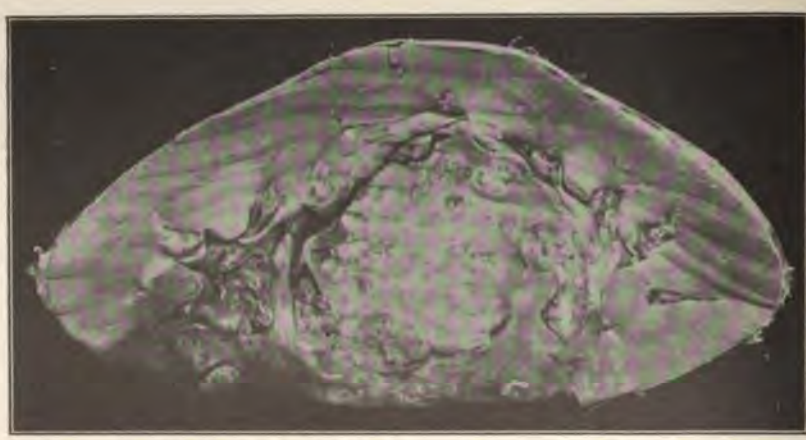

Fig. 16.—Carcinoma of the Renal Parenchyma.
From the Lab'y at the Boston City Hospital. No. S04.768. Case of Dr. L. R. G. Crandon, Boston, Mass.

On section, the color of the growth is either gray, yellowish, or reddish brown. The capsule resists for a considerable length of time, but finally softens, breaks down, and allows extension of the growth to the surrounding tissues and organs. In carcinoma this softening and breaking down with involvement of surrounding structures is a distinctive feature of the disease and occurs much more frequently than in the case of hypernephroma. The growth generally involves the pelvis of the kidney, and it may extend to the ureter, travel along the whole course of this canal, and the outrunner has been observed to enter the bladder[1]. In the records of the Boston City Hospital are the notes of a case[2] in which the growth travelled down the ureter and was found at autopsy extending into the bladder as a firm, adherent, reddish plug. This extension to the pelvis and ureter explains the persistent hematuria which is characteristic of these cases. The spread of the disease may be along the course of the blood vessels especially the veins, and thrombi are formed, which if loosened find their way to the heart and lungs and may cause death; detached cancerous masses may also cause death in a similar manner. In other instances, if the embolus is not large, it may serve to disseminate the disease in the lungs. The clotting in the veins is sometimes very extensive. A thrombus may form in the vein of the affected side, which may extend to the vena cava, and even to the opposite renal vein. In such a case the thrombosis may seriously interfere with the circulation of the blood in the abdomen, and may be the cause of ascites with its attendant symptoms and complications. A case of this kind is to be found in the records of the Boston City Hospital[3]. The patient had never suffered from any kidney symptoms whatever, and entered the hospital complaining of nausea, vomiting, and other gastric symptoms; there was likewise a con-

[1] J. Bland-Sutton, Tumors, Innocent and Malignant, London, 1907, p. 367.
[2] Path. Rec. No. S04.768.
[3] Path, Rec., No. 06.111; Third Med. Rec., Vol. 221, p. 16.

siderable degree of ascites. A diagnosis of cirrhosis of the liver was made, and the patient was treated for this disease. The man died, and at the autopsy the liver was found to be free from disease; but there was a malignant growth affecting the lower pole of the right kidney, and in the right renal vein there was a thrombus which extended into the vena cava and into the renal vein of the opposite kidney. The

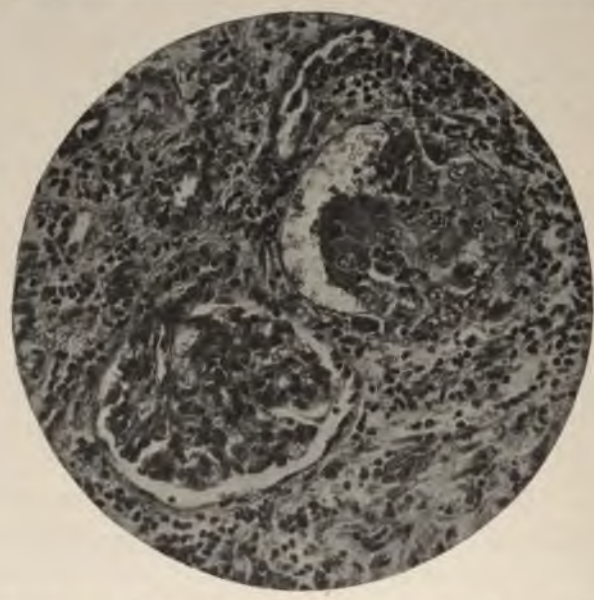

Fig. 17.—Carcinoma of the Renal Parenchyma, showing invasion of the Intima of a small Blood-vessel on the left with Cancer Cells and illustrating one of the methods of Metastasis.
From the Lab'y at the Boston City Hospital. No. S05.901. Case of Dr. F. S. Watson, Boston, Mass.

growth of the disease takes place within the walls of the blood vessels. This is well shown in Fig. 17. The case was one in the hospital service of Dr. F. S. Watson, and the illustration shows very well the growth of the disease in the blood vessels.

Extension through the lymphatic system is also frequent, the glands usually affected being those of the hilus of the kidney, the subclavicular, and those of the groin. When once the kidney has been disorganized and the tumor has

burst through the capsule, extension by direct continuity has free scope. The organs usually attacked secondarily are the lungs and the liver.

Pathology of Sarcoma

In the adult these tumors do not usually reach the enormous size seen in children. The following types are found in the kidney: the spindle cell, the round cell, the fibrosarcoma and the "angiosarcoma."

The tumors are soft as a rule, and on section have the appearance of a grayish mass with soft spots here and there, where degeneration has taken place. They are most frequently nodular, but may be diffuse. The capsule is most frequently the seat of origin of the growth, from which place the soft tissues are invaded, and in other instances the tumor starts at the hilus, and reaches the kidney substance along the course of the blood vessels. Either pole may be attacked.

The round cell variety is that in which the tumor proper consists of large numbers of small round cells with here and there numerous lacunae enclosing blood which in places penetrates the cellular masses. Delicate reticular tissue holds the tumor together. The growth is very vascular.

The spindle cells arranged in bundles are the characteristic feature of the spindle cell sarcoma (Fig. 18); these bundles are not isolated and microscopic examination will show that they penetrate between the tubules.

The fibrosarcoma may be briefly mentioned. In this tumor the fibrous tissue is greatly developed, producing a tumor of firm consistence.

It is impossible to classify the "angiosarcoma" as a tumor of strictly sarcomatous nature, for the reason that its histogenesis is not understood. Many observers, however, insist on calling this tumor a sarcoma, and will not admit that it can in any way be confused with the hypernephroma. It seems best to the writer, however, not to separate the

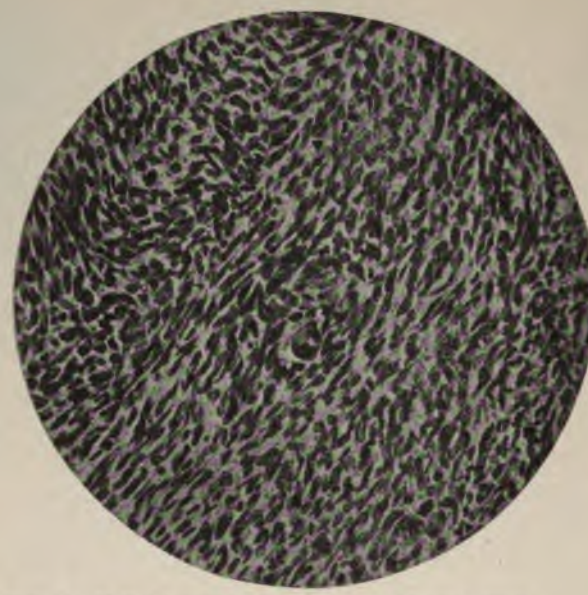

Fig. 18.—Spindle Cell Sarcoma of the Renal Parenchyma.
From the Lab'y at the Mass. General Hospital.

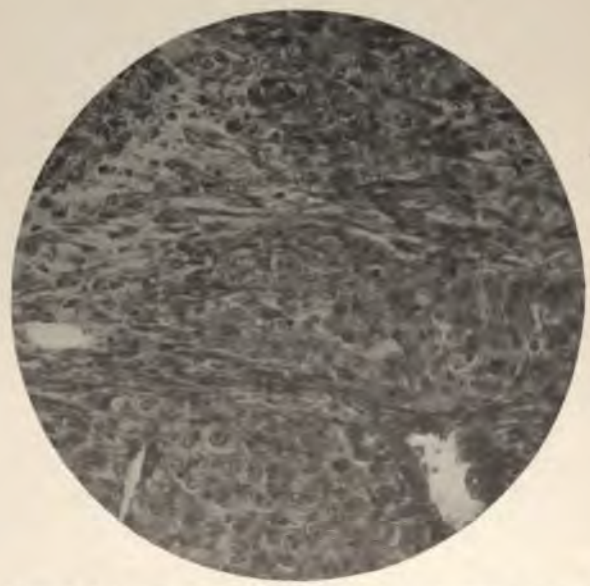

Fig. 19.—Round Cell Sarcoma of the Kidney, showing arrangement of the Cells in Alveoli (Alveolar Sarcoma).
From the Lab'y at the Boston City Hospital. No. S06.251.

angiosarcoma from the hypernephroma, because its characteristics are identical.

The liposarcoma is that in which, besides the usual characteristics of the ordinary forms of sarcoma, there is likewise a collection of fat tissue; the fat cells are arranged in the usual way.

There is a specimen of kidney tumor in the Boston City Hospital[1] which has been classified as sarcoma of the kidney. This tumor is remarkable on account of its extreme rarity. The chief feature of the growth is the arrangement of the sarcoma cells in alveoli (alveolar sarcoma) (Fig. 19), which are surrounded by fibrous tissue, in some places quite dense. The cells in the alveoli are smaller than the cells of polygonal shape seen in hypernephroma, and they are closely packed together, and do not in any place rest upon capillaries. In other parts of the growth, the alveolar structure is entirely wanting and the sarcoma cells lie in masses without any definite arrangement, penetrating the surrounding renal tissue. The specimen was obtained at autopsy from the body of a Chinaman who had the disease only seven months and died from the effects of operation. He was in a critical condition when operated upon.

Pathology of Adenoma

This form of tumor may be either benign or malignant. The benign form remains a local tumor, and does not give rise to serious symptoms; while the malignant adenoma spreads to surrounding tissues and gives rise to metastases.

The benign adenoma is found both in the healthy kidney, and in the kidney affected with chronic interstitial nephritis. The growth is seen in adults after the age of forty. It is usually situated under the capsule of the kidney, but it may be found in the medullary portion. It has a spheroidal shape, is encapsulated, may be single or multiple, and in size varies from that of a pea to that of a mandarin orange.

[1]Path. Rec., B. C. H., No. SO6. 251.

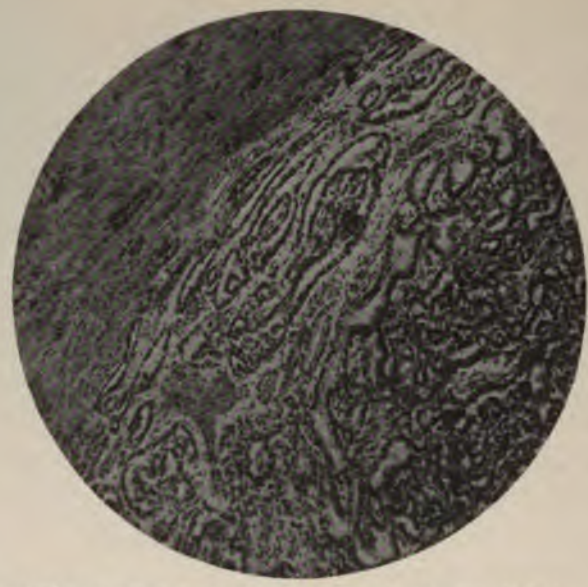

Fig. 20.—Tubular Adenoma of the Renal Parenchyma (X95). Showing arrangement of the Tumor in Tubules.
From the Lab'y at the Mass. General Hospital. No. 1093.

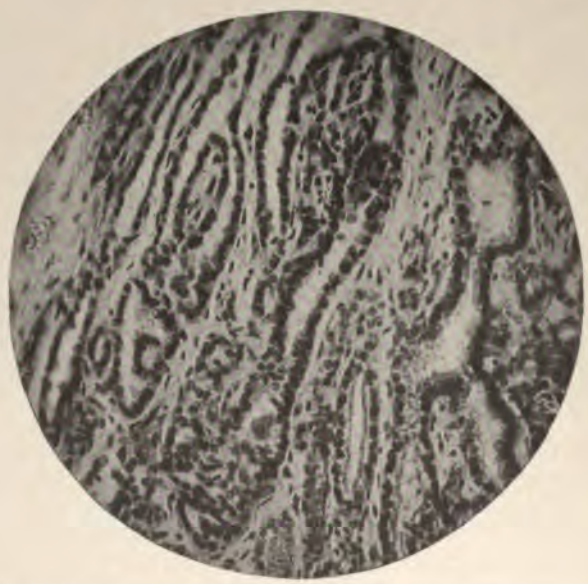

Fig. 21.—Tubular Adenoma of the Kidney, showing arrangement of the Tumor in Tubules (X190).
From the Lab'y at the Mass. General Hospital. No. 1093.

On section, it presents a grayish or reddish appearance, with here and there a cystic or hemorrhagic spot. There is a tubular form resembling adenoma of the liver histologically, which is characterized by the presence of cylindrical epithelial masses in tubular arrangement, some of which have a central clear space, the stroma being formed of light connective tissue (Figs. 20 and 21). There is also an alveolar form whose principal characteristic is the arrangement of the cells in alveoli which are separated by fibrous connective tissue. Finally, there is a papillary form which shows papillary growths in microscopic cavities (Figs. 22 and 23). This papillary variety is thought by many to be merely a different modification of the alveolar form, and not to possess any peculiarly distinctive character of its own. It is the form most frequently seen. Gross cystic formation is possible in all these three types of adenoma, especially in the papillary variety, and when this cavity formation is marked the tumor has sometimes been called cystadenoma, or "trabecular cystoma."

The malignant form of adenoma presents all the characteristics of carcinoma, although *in histologic structure it does not differ from the forms just described as benign.* The papillary type usually prevails, but the alveolar has also been frequently observed. The growth spreads to surrounding tissues by extension, may reach a large size and eventually may give rise to metastases in other parts of the body. Metastases, however, are not so common in malignant adenoma as in other kinds of growth.

The relation between the benign and the malignant adenomata is obscure. A majority of pathologists believe that the two are identical, and that they differ from each other only in a clinical sense. Histologically there is no difference between them. The malignant form has all the features common to carcinoma and eventually destroys life. The one peculiarity which it has is that it is not so apt to give rise to metastases as is the case in carcinoma.

Fig. 22.—Papillary Cystadenoma of the Kidney, showing arrangement of the papillae (X125).
From the Surgical Path. Lab'y at the Mass. General Hospital. No. 78.12.

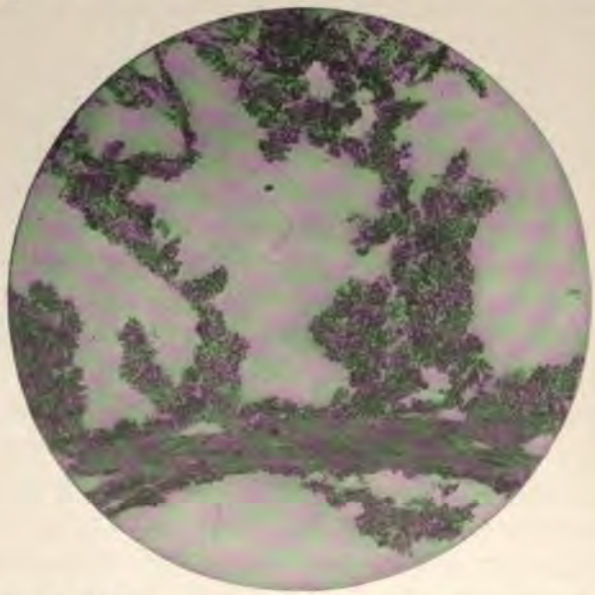

Fig. 23.—Papillary Cystadenoma of the Kidney, showing Papillary arrangement.
From the Lab'y at the Mass. General Hospital. No. 1521.

Symptomatology.

The following cases of carcinoma, sarcoma, and malignant adenoma of the kidney are reported in full because they are very rare and also because it will be possible to see wherein their clinical history differs from that of hypernephroma; the pathology is also given. The clinical history of these cases illustrates very well the symptomatology of these malignant growths, and it is especially to be remarked that in the cases of carcinoma the disease ran a very rapid course ending in death within a few months. This was likewise true of the case of malignant papillary cystadenoma, in which the disease also ran a very rapid course.

Case 1.—CARCINOMA OF THE KIDNEY. *(Third Surgical Record,* Vol. 137, p. 148. *Autop. Rec.,* B. C. H. No. S05.901).

The patient entered the hospital Nov. 13, 1905. He was an unmarried man, forty years of age. He had always been well up to a month before entering the hospital; during that time he had noticed a whitish sediment in the urine and there had been shooting pains in the right iliac fossa with severe exacerbations, the pain occasionally shooting up to the mammary region and down into the right testicle. There had been severe chills on several occasions and there had also been abundant hematuria. At the time of entering the hospital he had a running temperature of 101 degrees to 102 degrees F. which kept up from Nov. 9th until Dec. 17th, the date of his death.

This patient when examined on entrance had a great deal of pain and tenderness on pressure immediately under the right ribs, and palpation disclosed a tumor in this situation. There was a good deal of spasm of the muscles over the right kidney. An X-ray picture was negative.

The patient was operated upon by Dr. F. S. Watson on Nov. 23d, 1905, and he survived the nephrectomy only twenty-two days. The wound did perfectly well and death was caused by exhaustion.

The notes of the AUTOPSY are in part as follows: Lungs: "There are numerous opaque white elevated nodules from 2 mm. to 1.5 cm. in diameter, scattered throughout the lung tissue." Kidney: "The right perirenal tissue is replaced by a firm, dense, white, opaque, irregular mass in which are numerous broken down necrotic areas communicating by sinuses with the external wound. Overlying the aorta is a firm mass 5 cm. in length and 2 cm. in depth. In the vena cava are found two firm mottled red and white masses adhering each by a small point to the vessel wall. One of these masses is 4 cm. in length and apparently occludes the vessel." Nodules were also found in the liver, diaphragm, diaphragmatic peritoneum, and cervical and bronchial lymph glands.

MICROSCOPIC EXAMINATION: Liver: "There is a large neoplastic nodule of a character very similar to that in the lungs except that there is a more marked tendency to alveolar arrangement. There is an occasional gland. Many of the branches of the portal vein are plugged with masses of neoplastic cells or contain free cells of the same type. In some places there is direct extension of the neoplastic tissue from the portal branches into the capillaries between the liver cells." Kidney: "The kidney removed at operation is an organ firm in consistence and torn apart into masses. Next its junction with the pyramids there is a narrow band of slightly elevated opaque white tissue, often occurring as nodular formations and sometimes showing central yellow necrosis. Linear formations of opaque whitish tissue with dark red margins occur at times in the pyramids running parallel with the blood vessels."

The minute structure of the growth in the kidney is well shown in Figs. 10 and 11. The chief characteristic is the arrangement of the cancer cells in masses and columns. This is well illustrated in Fig. 12, which shows a dense infiltrating mass surrounded by normal renal tissue. With the high power lens this mass is seen to con-

sist of closely packed cancer cells which infiltrate the surrounding parenchyma. On the borders of this mass may be seen columns of the growth which are made up of tumor cells and which spread out into surrounding parts. There is not at any part of the growth any disposition on the part of the cells to lie close to capillaries as in the case of hypernephroma.

Commenting on the growth as a whole with its metastases the following is noted: "The cells exceed the stroma in amount. The stroma consists of fairly dense connective tissue. The cells are irregular with faintly basophilic protoplasm with nuclei varying from small dense masses to large vesicular types. Mitoses are frequent. The cells are arranged chiefly in cords or masses, but occasionally there is found a well formed alveolus. Areas of necrosis are frequent."

This specimen of kidney tumor illustrates exceedingly well the formation of the cancer in columns and masses. The following case shows the arrangement of the cancer cells in alveoli.

Case 2—CARCINOMA OF THE KIDNEY. (*Autop. Rec.*, B. C. H., No. S04.768).

This patient was under the care of Dr. L. R. G. Crandon, who kindly placed the case at the disposal of the writer. The patient was a woman thirty-seven years of age, who had been complaining only six or eight weeks of soreness in the back of the left chest near the spine. There was likewise a dull, heavy ache in this situation. She entered the hospital Sept. 13th, 1904. Besides the pain there had been attacks of hematuria. Examination of the urine showed a specific gravity of 1018, a trace of albumen, a daily amount of seventy-two ounces, and, on examination, the sediment was found to consist of blood and some squamous epithelium; there were no casts.

The examination of the abdomen was negative except

a feeling of increased resistance in the left loin in the region of the kidney.

The patient was operated upon by Dr. Crandon on Oct. 22d, 1904, and a kidney of normal size except for a hard rounded mass in the middle of it was removed, with three-quarters of the ureter.

The patient did fairly well for a few weeks, but began to fail by the middle of December, 1904, when the pain reappeared in the back of the left chest, and there was likewise pain in the iliac region on the left side. She rapidly failed after this and died Feb. 18th, 1905, having been ill about six months in all.

The notes of the AUTOPSY are in part as follows: "There is a scar in the left lumbar region bluish in color; at its upper extremity there is an irregular circular area 4 cm. in diameter which is similarly colored and which has a knobbed surface. At the lower end of the scar are numerous knobbed elevations of skin 5 cm. and smaller in diameter. The line of the scar and areas at each end are dense to the touch. There is diffuse infiltration of the ilium. The aorta and inferior vena cava are buried beneath a nodular tumor mass continuous with the left side. Lungs: Each lung contains numerous dense, white, spherical or ovoid nodules scattered beneath the pleura .75 cm. in diameter and smaller. Bronchial lymph nodes are large, dense, and white. Liver: Large and extends 10 to 12 cm. below the costal margin. It is thickly studded with tumor masses 5 cm. in diameter and smaller. These masses project above the surface of the liver. They are irregularly spherical, often with a depressed centre. The central portions of the larger masses are red and softer in consistence than the peripheral which are white and firm; the extreme periphery is often yellow though this zone is only one to a few mm. thick. Color of the liver tissue is pale reddish brown. Occasionally a vessel is filled with a white, firm homogeneous plug. There are several glands 2 to 3 cm. in diameter in the mesentery anterior to

the foramen of Winslow. Kidneys: The left kidney is absent. The right kidney is large and injected. The left kidney region is filled with tumor mass occupying the whole of the posterior abdominal wall on that side flush with the anterior surface of the vertebrae and over and underlying the aorta and vena cava. Superiorly the tumor is surrounded and covered with peritoneum. Inferiorly the tumor mass extends to the brim of the pelvis and infiltrates the psoas muscles. The mass also communicates with the scar made at operation. The tumor consists of two parts, a central and a peripheral. The latter is made up of infiltrated fat and muscle tissue and consists of white nodules 2 to 3 cm. in diameter and smaller, imbedded in fat or muscle and surrounded by a varying amount of fibrous tissue. The central portion is reddish gray in color with small irregular yellow areas, and is 5 by 7 cm. in diameter at the thickest or central portion. The left ureter is imbedded in the peripheral part of the tumor and, save for the upper end, is apparently normal. The upper end is indistinguishably fused with tumor tissue. The right adrenal is greatly enlarged and its centre is occupied by a tumor 3.5 by 3 cm. in diameter, one half of which appears to be blood clot; the other is a firm mottled yellowish white and red mass. Superiorly and inferiorly there is a small amount of normal appearing tissue. Superiorly in the medulla is a small white nodule 2 mm. in diameter. The left ureteral orifice in the bladder is plugged by a projecting adherent firm reddish plug. Both the uterus and the ovaries contain firm small white nodules. Metastases of the growth were found in the following organs: lumbar region, adrenal, liver, lungs, ovaries, uterus, and skin."

The MICROSCOPIC EXAMINATION of the tumor of the kidney is well illustrated in Fig. 9. There was a typical arrangement in masses, the cancer cells lying without any definite arrangement and infiltrating the renal tissues, especially the glomeruli. There was no structure which suggested hyper-

nephroma, such as papillary formation or arrangement of epithelial cells upon capillary walls. In the gross the kidney was 12 cm. in length and 6 cm. in width. There was a hard mass in the renal pelvis which was grayish in color and 4 by 5 cm. in dimension, with small yellowish islands. The mass for the most part occupied the pelvis and the adjacent renal parenchyma, but section of the parenchyma of the kidney showed that the whole organ was infiltrated. The capsule was not broken through.

Case 3.—Carcinoma of the Kidney.

This was a patient in the practice of Dr. H. E. Nichols, who kindly permitted the writer to report the case. The man was twenty-six years of age, a carpenter by trade, who had never had any previous illness. The family history was good, his father having died of pneumonia, and his mother and four sisters being alive and well. A half sister had died of pulmonary tuberculosis. There was no history of venereal disease. The patient was first seen February 22, 1904. Six months before this date he suddenly became ill with headache and general malaise; there was likewise some constipation, which was followed by a diarrhea and fever. This attack lasted four or five weeks, during which time there was marked distaste for food. He gradually got better and resumed his work. He soon began to have pain in the left side and loin which gradually got worse and became so severe that he was obliged to cease working. The pain was very severe, especially at night, and he walked with a limp. There never was hematuria at any time during the course of the disease.

On physical examination he was thin, with a drawn face, rather hectic, and stood with a rigid spine. He walked with a left-sided limp which was not characteristic of hip or spine disease. There was fair nutrition, a clear eye, and a clean tongue. The right testis was somewhat enlarged and slightly tender. On the posterior surface there was a nodule

three quarters of an inch in diameter, not movable, and not separable from the testis; it was quite firm, somewhat nodular, and a little tender; there was no fluctuation. The back was rigid in the lumbar region and there was spasm of the erector muscles; there was no knuckle, and the back was flexible on motion. In the left loin there was much tenderness on pressure and a small, firm nodule was found lying deep; there was no definite fluctuation. The abdomen was relaxed for the most part, and in the upper left quadrant there was a tumor the size of two fists, which was tense, quite tender, and projecting below the edge of the ribs; it was somewhat movable with a convex surface pointing downwards; it was impossible to tell about fluctuation. Extending from this swelling was a cord apparently the size of the little finger following the line of the ureter, which was somewhat movable and slightly tender.

The operation was performed March 1st, 1904, and on incising the kidney capsule a small abscess was opened which contained about four ounces of pus. There was no kidney structure apparent in the tumor below the abscess, and instead there was a red friable mass which was removed piecemeal with the greatest difficulty; attending its removal there was an alarming hemorrhage which was with difficulty controlled by packing; at least a quart measure of friable mass was removed. The wound healed perfectly without complications. The patient, however, rapidly failed after the operation and died from exhaustion within a month. There was severe pain in the lumbar region toward the end of life.

No autopsy was allowed, but there was no evidence of metastasis in any part of the body. The disease was of only seven months' duration from the beginning of the first symptoms to the end.

A MICROSCOPIC EXAMINATION of the tumor removed showed arrangement of cancer cells in columns and masses; there were well formed alveoli with fibrous tissue stroma interven-

ing, which in some places was quite considerable. The whole kidney was infiltrated (Fig. 13).

Case 4.—SPINDLE CELL SARCOMA OF THE KIDNEY. (*Hosp. Rec.*, Vol. 35, p. 82; *Surg. Lab. Rec.* M. G. H. No. S.911.7).

This patient was an unmarried female, forty-nine years of age. Her father died of heart disease, her mother of dysentery, and her brother of pulmonary tuberculosis. She had always been perfectly well.

Three years previously she had suffered a good deal from backache, and had not been able to walk about very much since then. The pain gradually left the back and settled in the left side under the ribs. There was a history of hematuria at the onset of the trouble. There has been no injury and no other assignable cause for the pain. Since the first attack of hematuria she has passed blood three or four times, at intervals of from three to six months; there has been no attack of hematuria for a year. The pain was of a paroxysmal character and was quite severe at times. She thinks there has been no variation in the amount of urine, and there has been no pain on urination, and no increased frequency. About six months previous to entering the hospital she noticed a tumor in the left hypochondriac region, and she says that this has lately increased very rapidly; she thinks that it is smaller at times. Since the advent of the tumor the pain in the side has been very much worse; it is a dragging sensation which seems to run through the abdomen; it interferes with her walking, and she has been obliged to give up her work. She has lost much weight lately. She suffers a good deal from constipation.

On physical examination she is a sallow, cachectic looking woman, but there is not marked emaciation. The heart and lungs show nothing abnormal. There is a distinct abdominal fulness which comes forward to the mid-line. On palpation a hard, smooth, firm mass can be felt in the left hypochondriac region which runs well into the flank and

can be moved back and forth between the examining hands. The mass is slightly tender to the touch, but has no fluctuation; with respiration there is a distinct downward movement of the mass. On inflating the bowel with air, percussion shows tympany on the inner edge of the tumor. No notches can be made out along the anterior edge of the mass. There has been no variation in the amount of urine since the patient entered the ward. On examination the urine was pale, neutral, contained a large trace of albumen, no sugar, and the sediment, which was considerable, contained much pus, squamous epithelium, a few small round cells, but there were no casts. The white blood count was 9000.

The patient was operated upon, and a large kidney tumor was removed by extra-peritoneal incision in the left side. She was discharged relieved at the end of a few weeks, and was advised to have treatment with erysipelas toxins.

The kidney which was removed had at its lower end a solid mass which gave to the organ a pear shape. "The entire length was 16 cm. and the greatest diameter at the lower end was 10 cm. On section is was seen to be a new growth of a flattened, globular outline, measuring 9 by 10 cm., of a grayish, homogeneous aspect, with slight translucency about the edge, while the centre was opaque, yellowish, and necrotic. Reaching out into the normal renal tissue were several small similar nodules, and a mass of the growth was seen projecting into the renal vein, which was greatly enlarged. The upper end of the kidney was normal, and its substance grooved over onto the end of the tumor, and was lost in it. The cortex of the kidney measured 9 mm."

MICROSCOPE: "The growth showed that it was made up entirely of spindle-shaped cells in which the blood vessels were represented by spaces hollowed out in its substance. Spindle cell sarcoma."

Case 5.—ALVEOLAR SARCOMA OF THE KIDNEY. (*Second Surgical Rec.*, Vol. 460, p. 6; *Autop. Rec.*, B. C. H. S06.251).

The patient was a Chinaman, 55 years of age. He could

speak but little English, and only a meagre history could be obtained. The duration of the disease from the first symptom until death was only seven months. For four months preceding his death there had been severe hematuria. The principal feature of the disease was gradual failing in health and strength; he had been obliged to take to his bed shortly after the disease began, on account of weakness.

In the left hypochondrium there was slight dulness and indefinite resistance on palpation. The abdomen was slightly distended but not tympanitic. An indefinite mass could be made out on bimanual palpation on the left side.

He was operated upon March 27, 1906, and died the same day. At the time of the operation he was in a greatly reduced condition, and it was explained to his friends that the operation offered but little hope.

A complete autopsy was not allowed. The tumor was examined and with a microscope showed an arrangement of cells in alveoli in many places (See Fig. 19), the alveoli being surrounded by fibrous tissue, in some instances considerably developed. The cells in the alveoli were rather smaller than the polygonal cells ordinarily seen in hypernephroma, and they were closely packed together without resting on capillary walls. In other parts the cells were without any definite arrangement and appeared in the slide as dense masses lying side by side crowded together, and on the borders of the masses the surrounding renal tissue was invaded by them. Alveolar sarcoma.

Case 6.—MALIGNANT PAPILLARY CYSTADENOMA OF THE KIDNEY. (*Third Med. Rec.*, Vol. 222, p. 16; *Autop. Rec.*, B. C. H. No. 06.111).

This case was remarkable, not only on account of the rarity of the tumor, but also because of mistaken diagnosis. The patient presented every evidence of cirrhosis of the liver and he died without having given any evidence of renal disease. The tumor was a discovery at autopsy.

The patient, a male, 56 years of age, entered the hospital May 15, 1906, with a history that he had been ill only ten weeks. The first symptom noticed was weakness in his lower limbs, and he was obliged to give up work because he could not walk. When he came to the hospital he complained of constipation, much nausea, a good deal of flatulency, vomiting, and swelling of the feet and legs. On examination he was found to have poor nutrition, slight jaundice, considerable edema of the legs, especially on the right, and a greatly distended abdomen, which was due to an accumulation of fluid within it. There was never any pain in the kidney regions, no hematuria, and no symptom of any kind suggesting kidney disease. The urine was acid, had a specific gravity of 1024, with the slightest possible trace of albumen, and on examination of the sediment an occasional hyaline cast with renal epithelium adherent, a few small round cells, and a few crystals of calcic oxalate were found.

The patient lingered for two weeks, and then suddenly died. A complete AUTOPSY was obtained.

Liver: "There is no evidence of cirrhosis."

Left Kidney: "This organ shows evidence of congestion only. Its capsule strips with difficulty leaving a slightly roughened surface. The cortex is light gray throughout, and the small vessels stand out prominently. The Malpighian bodies are easily visible as small glistening points. The vessels of the pyramids are easily visible, being somewhat distended. A few scattered, small, definitely walled areas, which contain a small amount of thin, clear fluid, are seen throughout the pyramidal region. The left renal vein is patulous to within 1 cm. of its opening into the vena cava. Here the vessel is plugged by a soft red mass similar to that seen in the vena cava. At the free end of the mass within the renal vein a small amount of clotted blood is adherent. The left spermatic vein is distended."

"The right kidney is increased in size and is firmly adherent to the surrounding tissues. Throughout the immediate

perirenal tissue there are numerous small, distended veins which extend in this region. The right kidney measures 14 by 10 by 5.5 cm. Its surface is roughened, and its lower half presents several round protruding areas which feel quite soft. The upper half is not so rough, and feels firmer. The right adrenal is removed with difficulty. The capsule of the right kidney is firmly adherent to the underlying substance. The right renal vein stands out very prominently and feels as if filled with a soft, elastic material. On section of the kidney, the lower half contains several round, grayish red protruding soft areas, the contents of which are rather granular, especially in the central portions. They are circumscribed, and between them the tissues are much firmer, and white in color. The upper half of the kidney contains numerous fairly well circumscribed, pale red and light gray areas. In contrast to the lower half the upper is quite firm throughout, less so in the red areas. The left ureter is patulous. The right renal vein contains a light red, soft, stringy material which completely fills it and extends upward into the vena cava, which stands out prominently and feels soft. Upon opening the vena cava a very soft, stringy, pale red mass spreads out over the edge of the cut. This material extends from a short distance below the entrance of the right renal vein to a point a short distance beyond the exit of the vena cava from its groove in the liver; it also extends for a short distance into the left renal vein on the opposite side. Below the lower point of this occluding mass there is firmly adherent to the wall of the vena cava, a thin, elastic material, the surface of which is dark red, the deeper portions a light gray. Adherent to the vena cava in the region of the renal vein is an enlarged lymph gland, which on section contains a soft, pale red material."

"Anatomic diagnosis: carcinoma of the kidney; carcinomatous occlusion of the inferior vena cava; carcinomatous occlusion of the right renal vein; carcinomatous occlusion of the left renal vein; carcinoma of the retroperitoneal

lymph glands; ascites; dilatation of the veins of the portal system; congestion of the left kidney; congestion of the adrenals."

Microscope.—Right kidney: "There is marked congestion with sclerosis involving the interstitial connective tissue and glomeruli; the former is slight. There is lymphocytic infiltration in situations principally just beneath the capsule. Only a few glomeruli are affected, and these generally are within sclerotic areas. The degree of sclerosis varies from slight to complete, with hyaline degeneration. There are a good many hyaline casts. A few desquamated epithelial cells show varying stages of degeneration. Some of the epithelial cells are intact, showing vacuolation. A few of Bowman's capsules are thickened by dense connective tissue. There are many embryonic glomeruli. A second microscopic slide shows the same general picture as the preceding, with more of Bowman's capsules affected. A third slide shows a rather more diffuse increase of interstitial connective tissue with lymphocytic infiltration. The large arteries show marked sclerotic changes. In the pyramidal area there is a tumor mass which is sharply defined and separated from the kidney substance by a connective tissue capsule which in places shows lymphocytic infiltration, in places involving the surrounding kidney substance. *The tumor belongs to the papillo-cystoma type.** A cyst from the wall of this tumor contains trabeculae lined with tumor cells and grows inward into the cyst, presenting a varied picture depending on the number and extent of branching by the ingrowing trabeculae. The number and size of these cysts vary. They are separated from one another by bands of connective tissue, throughout which are blood vessels and a few scattered large cells, which are filled with yellowish pigment. The size of the ingrowing trabeculae varies. They all contain capillaries in varying numbers. Some trabeculae show proliferation of endothelial cells. The cells lining the

*The Italics are the writers.

cysts are generally columnar in shape, their basements staining light pink, their periphery light blue and granular. The nucleus is rather large and clear, and shows a sharp nucleolus, some showing two. In some cases delicate lines seem to radiate outwards into the nucleus from the nucleoli. Within the cysts' cavity are a few degenerated cells in various stages of degeneration. Very few mitotic figures are seen. Very rarely a tumor cell is seen within the connective tissue beneath the layer of tumor cells. Within some of the trabeculae are fibrinoid changes. A fourth slide shows the same general picture as the third, with the capsule less defined, and there is more desquamation of cells. The vessels of the trabeculae are dilated, some showing an increase in polymorphonuclear leucocytes. The tumor cells differ from those described above. The nucleus stains darker, the nucleoli are less marked, and a good many cells show mitosis. There is intracellular yellow pigment within the connective tissue. Other sections show the same general picture. In some places there is blood in the cysts. The amount of pigmented cells within the connective tissue varies from a few to many."

According to the classification which has been adopted by the writer, this tumor would be called a malignant adenoma of the papillary type. The tumor, however, has been classified at the hospital as a "carcinoma" following Ribbert's system of classification. Ribbert classifies tumors of this kind as carcinomata. It is a "carcinoma" in the sense of being a malignant tumor. This growth did not give rise to metastases, probably because it did not have time enough to grow before death occurred; it is to be borne in mind, however, that adenomatous growths are not so prone to form metastases as is the case with other forms of malignant renal tumor.

The cause of death in this case was most peculiar. The man is suddenly taken ill with symptoms of weakness and severe general prostration. He takes to his bed and soon

dies with all the symptoms of cirrhosis of the liver, including a greatly distended abdomen. The cause of the ascites is clotting of the blood in both renal veins and vena cava, with interference in the circulation of the portal system. The case shows how the secondary complications may be the cause of death before the tumor has had an opportunity to grow.

From the foregoing it will be seen that the symptoms of malignant forms of tumor of the kidney are very severe, and that the disease may run its whole course within a few months. This is particularly the case in those forms of carcinoma in which the pure type of the disease exists. The round cell sarcoma is also very malignant, and may likewise run its course within a few months. The spindle cell sarcoma, as we have seen, may have a much longer duration, following the usual rule in the case of these tumors in other parts of the body. The disease is usually marked by symptoms of extreme prostration, and rapid loss of strength and flesh. The following table shows the duration of the disease in cases just cited:

Case 1.	Carcinoma	7 weeks
" 2.	"	7 mos.
" 3.	"	7 mos.
" 4.	Spindle cell sarcoma	3 yrs. (?)
" 5.	Round cell sarcoma	7 mos.
" 6.	Malignant papillary cystadenoma.	3 mos.

In the beginning of the disease there may be nothing more than malaise, headache, distaste for food, and some disturbance of the bowels. Local symptoms may be entirely absent during this time.

Pain is by far the most prominent symptom of the affection. The growth soon destroys the kidney capsule, and extension to the muscles and nerves in the vicinity of the kidney soon occurs, and this gives rise to the severe pain. In the beginning of the trouble there may be nothing more than

a soreness which may be referred to the back and sometimes to the front. The pain soon becomes excruciating, and is especially annoying at night. It incapacitates the patient early in the course of the disease, and is usually of much greater intensity than the pain experienced in hypernephroma. Radiation is not uncommon, and the pain may extend upward into the mammary regions, or downward into the testicles.

Next in importance as a symptom is hematuria. The disease soon involves the pelvis of the kidney and the ureter, and this accounts for the early and persistent bleeding which is characteristic of these cases. Occasionally, however, the disease runs its whole course without any hematuria whatever. The explanation of these cases is probably permanent blocking of the ureter. As in the case of hypernephroma, motion and exertion of any kind do not have much influence on the amount of blood lost.

Least in importance of the three cardinal symptoms is tumor. The extreme malignancy of the disease does not always permit of a large growth, and death may ensue before the tumor has reached a large size. If thrombosis of the renal vein and vena cava occurs of sufficient extent to seriously interfere with the flow of the blood in the large venous trunk, ascites may occur, and symptoms referable to this condition may assume prominence. In such a case the diagnosis is extremely difficult, if not impossible, especially if there have been no focal symptoms on the part of the kidney to attract attention to it, and if the growth is still small. We have seen that in the case of hypernephroma a somewhat analogous condition may occur. Reference is made to a large metastasis in some part of the body which alone attracts attention, and which has originated from a small unappreciable growth in the kidney substance. Fever due to suppuration about the kidney may occasionally occur, but, judging from the great rarity of perinephritic inflammation in hypernephroma, it must be of unusual occurrence.

The urine in cases of malignant disease of the kidney is not usually much altered. The amount may be normal, and, barring the presence of blood, there may be nothing more than a few casts and cells in the sediment. Inflammatory changes around the growth in the renal parenchyma which has been spared by the disease are the occasion of the appearance of these elements.

Examination of the kidney region may show a tumor and in most cases, especially if the disease has involved the capsule, there will be resistance of the abdominal muscles and sensitiveness on pressure.

Diagnosis

Carcinoma, sarcoma, and malignant adenoma usually have a very rapid course, the disease frequently coming to an end within a very few months. The rapid course is a significant sign of the affection, and should have due weight. A previous history of failing health, especially if there has been rapid, unexplained emaciation, even in the absence of any focal symptoms, should lead one to suspect some serious internal affection. When the localizing symptoms, therefore, appear, malignant disease must be the first to be considered. A person during middle age, or past this time of life, is more prone to the affection than a younger person, although we have seen that it may begin quite early in life. The severity of the pain is a marked feature, and is one which should have considerable weight in diagnosis. A small tumor with severe pain and rapid emaciation is indicative of this disease. Hematuria is apt to be a marked symptom because the growth rapidly invades the renal pelvis. Involvement of the glands about the kidney or even the glands situated at a distance, such as the axillary and the iliac, is most significant.

Sarcoma is rather more apt to occur at a younger age than carcinoma. Hypernephroma may develop at any age, but is most common between the fifth and sixth decades.

Adenomatous growths are more apt to occur earlier in life, and do not so readily give rise to metastases. It is also to be remembered that an adenomatous growth may originally be benign, may persist for a number of months, or even years, giving rise to no special symptoms, and may subsequently take on malignancy. Hematuria is a prominent symptom of carcinoma, and this disease is sure to undermine the system earlier than is the case with the other forms of growth. The more malignant the type of growth the earlier the cachexia appears. A bone metastasis is evidence of hypernephroma rather than of sarcoma or carcinoma, especially if the patient is not cachectic. Glandular involvement favors carcinoma in the presence of cachexia. In general, large tumors speak against carcinoma. Infiltrating cancer of the kidney does not cause a large tumor, but early infiltrates the surrounding tissues. Sarcoma may grow into a large tumor which likewise infiltrates surrounding tissues. Hypernephromata, on the other hand, have in many cases a very slow growth, and may remain for several years unchanged in size. Large, freely movable tumors are suggestive of hypernephroma. Carcinoma and sarcoma are more frequently attended by hematuria than is the case with hypernephroma. A long period of time between the first and second attacks of hematuria is suggestive of hypernephroma rather than the other forms of tumor; in the latter the intervals between the attacks are usually quite short. Finally, hypernephroma is by far more frequent than the other forms of growth.

It is not necessary to repeat all that has been said in regard to the differential diagnosis of abdominal tumors. This has been thoroughly discussed in the chapter on hypernephroma.

Treatment

The operative treatment of malignant disease of the kidney offers but little encouragement. Nevertheless, the symptoms are usually so severe that operation is in most cases imperative. Unbearable pain demands operation, and

so also does exhausting hematuria. One can never be absolutely sure of the exact nature of the disease, and in spite of the discouraging outlook an operation may be advisable.

The treatment of sarcomatous tumors by means of injections of erysipelas toxins according to Coley's method has not resulted in any cures. It may be useful in allaying the severity of the symptoms in some cases. Its chief value is its use as a prophylactic measure immediately after operation.

The history of the cases in which a competent histologic examination has been made shows that a long survival after operation is not to be hoped for. The writer cannot give a long list of cases in which operation was performed, because the reports of cases which have been examined leave much to be desired.

SURVIVAL AFTER OPERATION FOR CARCINOMA AND SARCOMA

Case	1.	Carcinoma	22 days*
"	2.	Carcinoma	4 mos.
"	3.	Carcinoma	1 mo.
"	4.	Spindle cell sarcoma....	(?)
"	5.	Round cell sarcoma.....	died immediately

This list is in accord with what J. Bland-Sutton[1] says in regard to survival after operation for carcinoma. It is unfortunate that the author does not give any figures or histories of cases with reference to this point. The author says: "A careful study of the disease shows that in those cases in which the histology of the tumor was fully determined more than one-half the patients from whom the kidney was removed died from the effects of the operation. This is partly due to the exhausting effects of the carcinoma and hematuria upon persons advanced in life. Of the patients who recovered from the operation I know of no record where life was prolonged more than a year." Speaking of the prognosis of sarcoma, J. Bland-Sutton[2] says: "The mor-

*See cases on pages 125 to 134.

[1]Tumors, Innocent and Malignant, 1907, p. 368.

[2]Loc. cit., p. 114.

tality of the operation is nearly as great as in renal sarcomata in infancy, for about one-half of the patients die after nephrectomy. Of those who recover, in nearly all recurrence takes place within a year, and in most of them within a few months."

BENIGN TUMORS

Pathology

The benign tumors of the kidney are not important. They are rare, as is the case with malignant forms of growth.

Adenoma has been mentioned in discussing the malignant growths. In histologic structure it cannot be differentiated from malignant adenoma.

Angioma is a very vascular tumor and has the usual characteristics of angioma, showing all grades of capillary dilatation. It varies in size from that of a pea to that of a walnut, and its situation is usually beneath the capsule, but occasionally in the medullary substance. It is very rare.

Lipoma is likewise of extreme rarity. It must be distinguished from the large deposits of fat around the kidney sometimes seen as the result of long-standing kidney disease. There is but one specimen of lipoma of the kidney recorded in the pathologic records of the Boston City Hospital during the past ten years. It was a small tumor 3 mm. in diameter, situated on the surface of one of the pyramids[1]. True lipomata are usually small, rarely larger than a cherry, and they are generally situated underneath the capsule. Warthin's case[2], however, was most remarkable. In this case the fatty tumor was the size of a child's head, and had the appearance of a dilated cystic kidney. Lipoma of the kidney consists microscopically of fatty tissue, the fat being enclosed in large cells which are held together by a reticular framework.

The fibromata are usually small. They are situated in

[1]Path. Rec., B. C. H., No. 00.51.
[2]Quoted by Kelynack, Renal Growths, London, 1898, p. 64.

the cortical substance of the kidney, but may likewise be found in the medullary portion. In the Mass. Gen. Hosp. there is a record of a small fibroma[1] 3 mm. in diameter, which was found in a pyramid of the renal pelvis. Their structure is of fibrous tissue. In some cases they take on active growth and attain a large size, weighing several pounds. Very rarely a tumor may be of considerable size, as in Bruntzell's[2] case, in which a fibroma weighed twenty pounds.

Symptomatology

Benign growths of the kidney do not, as a rule, occasion marked symptoms. Small growths may remain for a considerable length of time, even years, in the kidney without occasioning any symptoms whatever. When, however, they are of large size they may cause discomfort by reason of their weight and volume, and may give rise to symptoms referable to pressure upon other organs. It is only exceptionally that hematuria is a symptom of benign growth. Brodeur[3] in a series of ten cases of benign growth mentions only one, a very vascular fibromyoma weighing twenty pounds, in which hematuria was a symptom. When the tumor has reached a considerable size, pain may be very severe; as a rule it amounts only to lameness and backache. Edema from pressure, varicocele, constipation, and gastric disturbances such as nausea and vomiting are prominent symptoms when the growth is of large size. Under these circumstances there may be much loss of health and strength. The urine is not, as a rule, much altered by these growths. The benign adenomata do not give rise to symptoms when they are of small size, and they are of no more importance in a clinical sense than other forms of small renal tumors. Just where the border line is between benign and malignant adenoma is difficult to determine. When the tumor has begun to give rise to serious hemorrhages which render the patient

[1] Autop. Rec., No. 1839, M. G. H.
[2] Berlin klin. Woch., 1882, Vol. 19, p. 745.
[3] Affections du Rein, Paris, 1886, p. 215.

weak from anemia, when the pains appear, and when cachexia at last shows itself, it is evident that the tumor can no longer be called benign. It may, however, reach a considerable size before these symptoms appear, and its presence may not be suspected at all until the hemorrhages take place.

The following two cases occurred at the Massachusetts General Hospital. They illustrate the clinical course of the disease:

Case 1.—PAPILLARY CYSTADENOMA OF THE KIDNEY (*West Surg. Rec.*, M. G. H., Vol. 363, p. 191).

The patient, an unmarried female, fifty-four years of age, entered the hospital Sept. 27th, 1900. The family history was negative. She complained of lameness and pain in the back and left side, and these symptoms had been present for a year. There had been great loss of flesh and strength, especially during the past few months. A tumor was discovered about six months after the onset of the trouble, which, when first noticed, was about the size of a fist and was situated just below the ribs on the left side. Besides the pain and lameness, a good deal of distress and burning sensation was experienced after eating, especially during the three months previous to entrance. There was likewise some nausea, vomiting, flatulency, and constipation alternating with diarrhea. There was never any jaundice. On examination she was seen to be a well developed and well nourished woman, and there was no evidence of cachexia. Bulging out beyond the left costal border there was a tumor of the size and shape of a fetal head.

Nephrectomy was performed on Sept. 28th, 1900. The tumor was situated within the capsule of the kidney and the whole mass was removed. She was discharged much relieved at the end of a few weeks. She died shortly afterwards. The cause of death could not be ascertained.

The specimen was examined by the pathologist, with the following result: "The left kidney was of normal size. At

its upper end was a cyst which extended down well into the kidney. The kidney surface was rough and vascular looking. At the upper part of the organ there was a papillary outgrowth on the cortex and several smaller cysts were seen deep in the substance of the kidney. A loosely attached mass of this growth about the size of the end of a finger was removed at the time of operation."

MICROSCOPE: "An extremely involved papillary outgrowth, in the midst of which were occasional well marked cross sections of what appeared to be tubular glands. These papillary masses sprang from the cyst walls, and in places simple cysts, with but little evidence of papillary outgrowth, were seen. No direct transition from the cyst tissue to the kidney tissue could be seen, but, on the other hand, they passed insensibly into the nomal kidney tissue without any sharp line of demarcation. The appearance of the cyst was suggestive of an origin in the kidney tubules. The walls of the cysts and of the papillary outgrowth were covered with a single layer of rather large, somewhat cylindrical epithelial cells. Papillary cystadenoma."

Case 2.—PAPILLARY CYSTADENOMA OF THE KIDNEY (*West Surg. Rec.*, Aug. 3, 1907, *Surg. Lab. Rec.*, M. G. H. No. 78.12).

The patient, a male, forty-nine years of age, entered the hospital July 29th, 1907. One sister died of cancer of the stomach, but otherwise the family history was negative. There was no history of venereal disease.

The patient said that twelve years previously his urine suddenly became cloudy and a little bloody; during this attack he experienced a little pain at the end of micturition. Nine years previously he submitted to a suprapubic operation on the bladder, the nature of which he did not know.

He complains now of frequent micturition and has to rise three or four times at night to empty his bladder. At present there is no pain on micturition. The urine is now often

cloudy but does not contain any blood. The chief source of complaint is a severe pain in the left side and occasionally on the right side. This pain is very annoying, begins every day at one o'clock, lasts all the afternoon, and does not cease until midnight. His appetite has lately been very poor, and there has been a loss of weight of twenty-seven pounds.

On examination his tongue was seen to be thickly coated. Neither kidney was palpable. With a cystoscope the bladder was found quite normal, but coming from the mouth of the left ureter a thick stream of pus could be seen issuing; normal urine was escaping from the right side. An X-ray photograph showed nothing unusual.

Nephrectomy was performed on Aug. 3d, 1907. He was discharged relieved a few weeks later.

The pathologist's report is as follows: "A large sacculated kidney the size of a fist, with a thin cortex and the pelvic cavity dilated. The dilated calices are full of cloudy, purulent urine. The lining of the calices shows everywhere various sized soft gray nodules of a cheesy character resembling closely large tubercles. Cross section of the kidney substance shows these nodules to be dotted through the substance of the kidney in all directions. There is extensive dilatation of all the tubules, in almost every one of which lies a distinct hyaline cast. There is much thinning and degeneration of the tubular epithelium. The interstitial tissue is slightly increased and infiltrated with round cells. Some of the tubules are seen to be dilated to six or eight times their normal diameter, and in these cases the epithelium persists merely as a shred surrounding a large cast, and showing an occasional epithelial nucleus. There is a large increase in fibrous tissue in many parts of the specimen and marked thickening of the vessel walls. In some spots the tubules are entirely replaced by fibrous tissue. Section through the nodules described above shows them to be made up of extensive papillary hypertrophy of the kidney epithelium closely resembling papillary cysta-

denoma of the breast. Apparently this papillary growth occurs from the walls of a dilated tubule and is distinctly encapsulated. In some places the growth is so dense as to consist merely of a solid mass of epithelium. Occasionally one of these papillae can be traced growing directly from the wall of the cyst-like cavity, and everywhere firm basement membrane can be seen beneath the masses of cells. The tumor is markedly vascular. The glomeruli are all undergoing marked degenerative changes. Papillary cystadenoma of the kidney."

Diagnosis

The diagnosis is extremely difficult, and when the tumor is small it is almost impossible to make. If the tumor is of large size it may be confounded with growths affecting the abdominal contents, and the disease most frequently mistaken is ovarian tumor. Benign tumors are usually hard, except the lipomata, which are soft.

Treatment

These growths should be removed, especially if pressure symptoms are prominent. The operation is not attended with a high mortality, and the prognosis is good as it is in the case of benign tumors elsewhere in the body. The lipomata may, however, recur.

CHAPTER II.

EMBRYONIC TUMORS

The tumors about to be described are decidedly different from others found in the kidney. As their name indicates, they are supposed to take origin in embryonic tissues.

VARIETIES OF EMBRYONIC TUMORS

These tumors are of three main types: the dermoid, sometimes called teratoma, the rhabdomyoma, and the mixed tumors.

Dermoid

Dermoid growths contain heterogeneous tissue elements, resembling tissues normally found elsewhere. These tissues are more or less typical of the normal tissues which they represent. The perfect teratoma, which reproduces fetal parts most faithfully, must be regarded as a fetal inclusion. These growths have been explained in various ways. The most probable is, that as a result of some accident to the ovum in its early segmentation, or perhaps in consequence of faulty fissions in the young embryo, certain parts grow in an abnormal position. These misplaced tissues often remain dormant for a long while, and when they begin to grow they do so very slowly.

Dermoids are exceedingly rare in the kidney, and only two cases have been reported. The first was Paget's[1] case of a tumor which he had seen; the second was Haeckel's[2] case of a female fifty-eight years old, who had a dermoid in the kidney 11 cm. in width. These dermoid tumors in the kidney do not differ from those seen elsewhere in the body;

[1]Lectures on Surgical Path., London, 1853, Vol. 2, p. 84.
[2]Berl. klin. Woch., 1902, Vol. 39, p. 964.

skin, hair, fat, and other tissues are found, and the cyst contains a semi fluid or grumous material.

Rhabdomyoma

The rhabdomyomata, as well as the mixed tumors, have sometimes been called teratomata, because they contain tissue which is not normally found in the kidney. The rhabdomyoma was first classified as a distinct tumor by Rokitansky[1], who described a rhabdomyoma of the testicle. Brock[2] referred to Rokitansky's case and collected the published cases to the number of sixty-seven occurring in various parts of the body.

The growth is of very rare occurrence in the kidney. It is difficult to determine just how frequently it does occur, because many cases of rhabdomyoma have undoubtedly been improperly classified for the reason that their histological structure has not been thoroughly studied.

These growths may be the size of a fist, or larger. The mass is at times smooth, at times nodular, and has a rounded appearance. The kidney may be included in the growth, or it may form a part of it, and show as a nodule on the surface of the tumor.

Microscopically, the tumor consists of striated muscle which lies in a stroma of cells. It is by the multiplication of this muscle fibre that the tumor enlarges. All types of muscle cells are seen, each of which has a characteristic striation which distinguishes it from smooth muscle cells. They resemble voluntary muscle in shape and in staining reaction, but their color is different from the usual muscle cell. Examination, furthermore, shows that the muscle tissue never attains to full development of mature striated muscle, always stopping short of the production of perfect fibres with regularly disposed sarcous elements. In form and shape they closely resemble the muscle fibre seen in embryonic tissues. Some of the cells are of spindle form with a more or

[1]Zeit, f. Ges. d. Arzte., Wien., 1894, Vol. 5, p. 331.
[1]Zeit, f. Ges. d. Arzte., Wien., 1849, Vol. 5, p. 331.

less pronounced striation, but there are also oval, round, and regular shapes and the cells are often multinuclear, and striated fibrillae may surround the nucleus in concentric lines. Fibrillae are sometimes found in the microscopic fields, which look like connective tissue fibrils, but there is this difference, that there is a cross striation. Glycogen droplets are often found in these muscle fibres, and this has been brought forward as proof that the tumor is of embryonic character. The length of these fibrils is sometimes quite considerable.

The stroma of the rhabdomyoma consists of finely fibrillated interstitial tissue with a few nuclei. Sometimes the interstitial tissue is made up of young muscle cells which have not yet been striated, and they appear like connective tissue cells. In these cases it is very difficult to distinguish the tumor from a sarcoma, and, in fact, many of the features of the pure rhabdomyoma are strongly suggestive of sarcoma, so that it is not easy to decide how far a combination of myoma and sarcoma may really occur. The border line between rhabdomyoma and the mixed tumors, about to be described, is therefore a very narrow one, and many authors contend that there is no such thing as a pure rhabdomyoma occuring in the kidney. Ribbert[1], however, has classified a pure kidney rhabdomyoma, and in what has preceded an attempt has been made to follow along the lines that he has laid down with regard to these growths. Ribbert[2] previously tried to overcome this difficulty by describing tumors containing striated muscle with a sarcomatous stroma, as "sarcoma with striated muscle fibres;" but it is probably better to put these growths in the mixed tumor class, because these tumors contain two tissues proliferating independently of each other. The writer in a careful analysis of one hundred tumors, in which a competent microscopic examination had been made, found that a combination of striated muscle with

[1]Geschwülstlehre, Bonn, 1904, p. 297.
[2]Virch. Arch., 1892, Vol. 130, p. 271.

sarcoma occurred in twelve per cent. of the cases. Of course, it is possible that structures common in mixed tumors might have been present and were not found, and the above percentage must be taken with this proviso.

Quite recently Wollbach[1] has called attention to the common existence of cerebral sclerosis with rhabdomyoma. Wollbach states that in a series of twelve cases of rhabdomyoma of the heart, seven had cerebral sclerosis, and he mentions the possibility of a like condition with kidney tumors. Wollbach likewise refers to Yacobaeu's[2] twenty-five cases of "hypertrophic tuberous cerebral sclerosis," seven of which were associated with multiple tumors of the kidney. It should be stated, however, that in the Yacobaeu cases a histologic examination of the kidney was omitted in the majority. In the published reports of cases of embryonic kidney tumors, the writer has failed to find any mention of cerebral sclerosis. The subject demands further investigation.

Mixed Tumors

The first definite attempt to separate the embryonic tumors as a class from other kinds of growth, was made by Birch- Hirschfeld[3], who recognized that these tumors presented peculiar features which he thought were distinctive. Birch-Hirschfeld showed that the epithelial and connective tissue elements found in mixed tumors bore a close resemblance to similar structures in the embryonic state, and it was he who first cleared up the confusion which existed in regard to these tumors.

The following are the names which have been given to the mixed tumors of the kidney: "embryonic adenomyosarcoma," "embryonic adenoma," "myosarcoma," "sarcoma carcinomatosum," "embryonal mixed tumors," "adenosarcoma," "teratoma," "adenocarcinoma," and "teratoid

[1]Jour. Med. Research, 1907, Vol. 16, p. 516.
[2]Nord. Med. Arch., Stockholm, 1903, 3 f., iii Apd. 2, No. 2.1.
[3]Centr. f. d. Krank. der Harn und Sex.-Org., 1894, Vol. 5, p. 97.

mixed tumors." This long list of names shows how confusing the subject has been.

These tumors present certain structures which have been called carcinomatous, but, as will be shown, the presence of sarcomatous elements, as well as the structure of the tumor, preclude the possibility of classifying these growths with the carcinomata.

Mixed tumors consist of at least two kinds of tissue, each

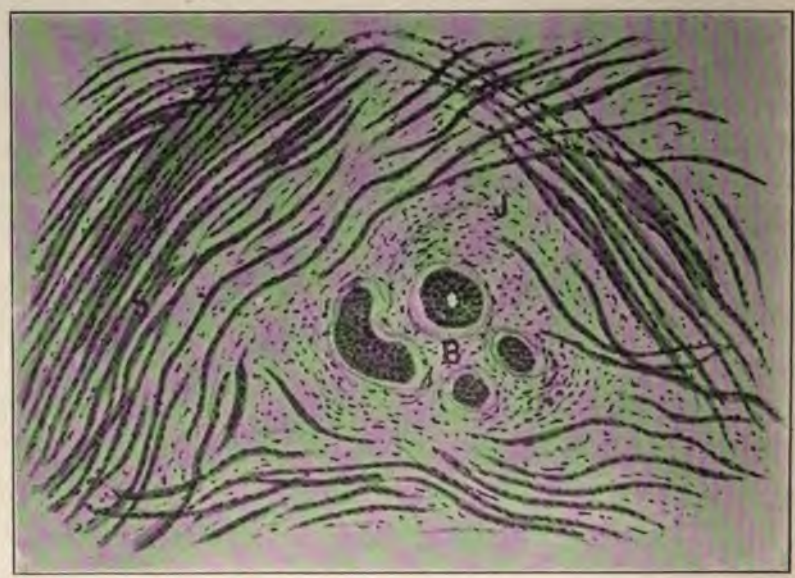

Fig. 24.—Mixed Tumor of the Kidney, showing Striated Muscles (S), Stroma (J), and Tubular Structures (B).
From Ribbert, Geschwülstlehre, Bonn, 1904, p. 632.

growing independently; if several tissues are present they grow in groups independently of each other. The rhabdomyoma in its pure form is composed of muscle fibre and connective tissue frame-work; but this frame-work does not proliferate . A mixed tumor does not exist even though the constituents present show two or three modifications which do not have the value of independent and unrelated tissues. These tissues do not always grow to the same extent; for instance, we may have a mixed tumor composed principally of connective tissue structures, while glandular elements which

form part of the mixed tumors may be relatively scanty. In a mixed tumor there may be striped and smooth muscle fibre, cartilage, fat, bone, epithelial structures in the nature of tubular or glandular structures, collections of epithelium, rudimentary substance from the central nervous system, and finally, proliferating connective tissue.

The occurrence of striated muscle (Fig. 24) is not infrequent. Walker[1] states that in only twenty-five per cent. of

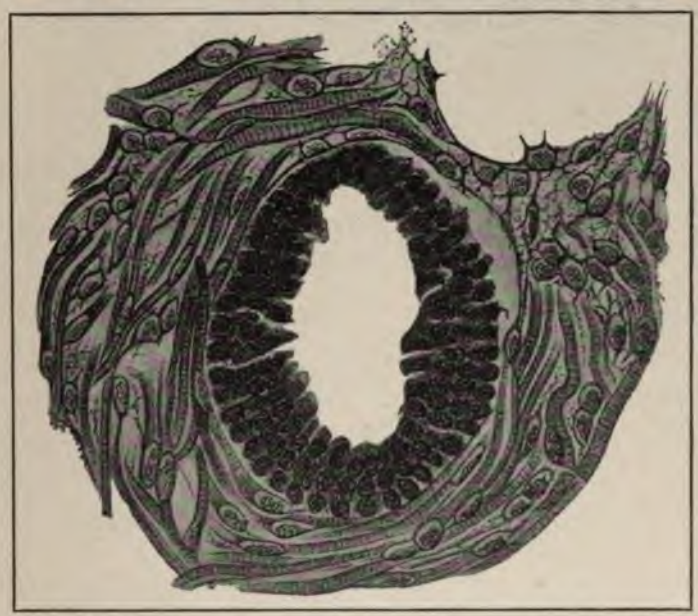

Fig. 25.—Mixed Tumor of the Kidney, showing Tubular Structure and Striated Muscle Fibre.
From Busse, Virch. Arch., 1899, Vol. 157, p. 372, Pl. VIII.

these tumors is there striated muscle, but the writer in a series of one hundred cases in which a careful microscopic examination has been made, found that striated muscle occurred in forty-two per cent. Bland-Sutton[2] states that when striped muscle is present, tubular structures are, as a rule, absent. The writer cannot agree with this statement, for in a series of forty-three cases in which striated muscle was present, in twenty, tubular structures were found, and

[1]Ann. Surg., 1897, Vol. 26, p. 549.
[2]Tumors, Innocent and Malignant, London, 1907, p. 105.

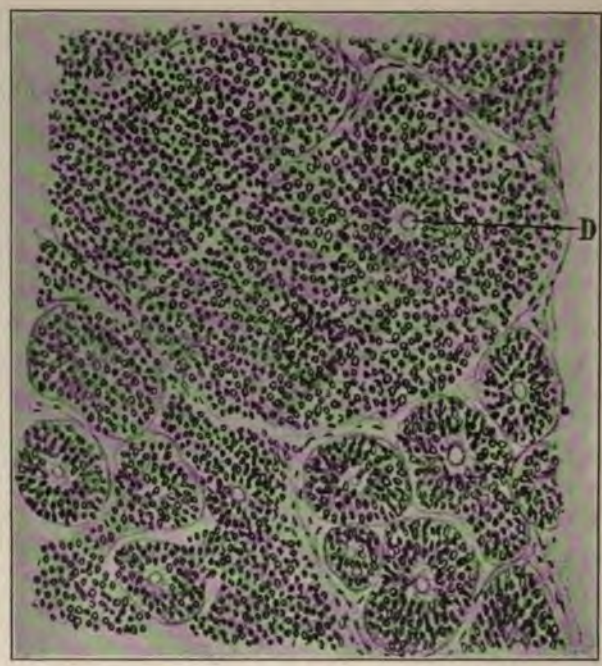

Fig. 26.—Mixed Tumor of the Kidney, showing Stroma of the Tumor, and Tubular Structures.
From Ribbert, Geschwülstlehre, Bonn, 1904, p. 636.

Fig. 27.—Mixed Tumor of the Kidney in a child one year and ten months old, showing Tubular Structures (X125).
From the Surgical Laboratory at the Mass. General Hospital. No. 64.65.

in twenty-three they were absent. The muscle fibre is not different from that found in the rhabdomyoma which has just been described. The fibres may be found everywhere in the tumors, either singly or collected in parallel bundles.

Smooth muscle fibres quite frequently occur in these growths. They are sometimes so intimately interwoven with the connective tissue as to give the impression of a uterine myoma.

Cartilage is found in islets scattered about in the substance of the tumor, and it is said to be more frequent in adolescence than in infancy.

Fat tissue is likewise seen in isolated collections in the growth. Bone is seldom found.

By far the most interesting structures found in mixed tumors are those which are derived from epithelium. The most important of these are the tubular or glandular structures (Figs. 25, 26, 27). For a long time the appearances suggesting glandular growth gave rise to the opinion that the tumor must be of adenoid formation, but this view has since been entirely abandoned. They are, in fact, according to Ribbert, really epithelial structures and should be so considered They occur in about forty per cent. of the reported cases. Microscopically they consist of tubules which on cross section show a lumen; cubical epithelium in rows two or three deep is placed upon the walls of the tubes. The epithelium bordering on the lumen is more cubical, while that next to the wall of the tube is inclined to be more or less flattened. There is likewise a basement membrane upon which the cells rest. The form and shape of these tubules does not in any way suggest the tubules seen in the normal kidney and they have, in fact, no connection with them. Many of the tubes are of simple, elongated formation, but others may have a lateral budding, or they may be dilated into cysts of various sizes and forms. These tubules may lie in groups forming lobules, and are separated by connective tissue or muscle;

occasionally they are found lying isolated in a stroma of sarcoma cells (Fig. 24 B).

Other forms taken by the epithelium are collections of larger or smaller groups and strands of cells, sometimes with central cornification, which freely anastamose (Fig. 28). The presence of these epithelial "pearls," as they are sometimes called, gave rise to the belief that the tumor must be in part a carcinoma. There is no suggestion, however, of carcinoma in these growths, and it is difficult to

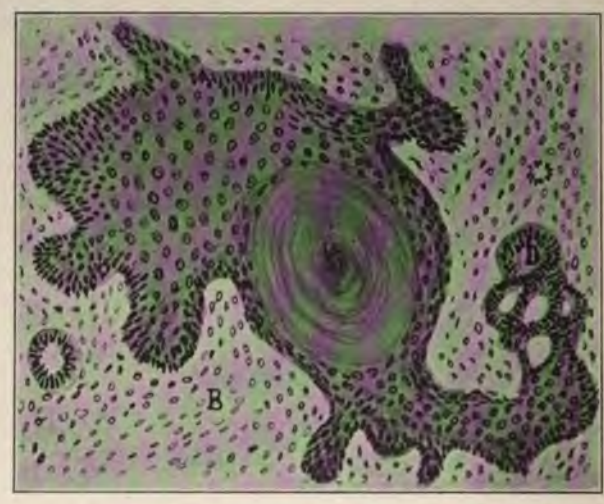

Fig. 28.—Mixed Tumor of the Kidney, showing Epithelial Structure with Central Cornification ("Pearl") (v), and Tubular Structures (D).
From Ribbert, Geschwülstlehre, Bonn, 1904, p. 633.

imagine a carcinoma in the presence of sarcomatous tissue; furthermore, it has never been shown that the epithelial "pearls" proliferate in the way that carcinoma epithelium does; and likewise in the tubular structures no one has ever seen the epithelium extend into the tissues in the vicinity. Mitoses are occasionally observed.

Ribbert[1] has likewise found a substance resembling rudimentary tissue of the central nervous system. He describes it as "a neuro-epithelial arrangement." Busse also

[1]Geschwülstlehre, Bonn, 1904, p. 630.

calls attention to this exceptional finding, but these two writers are the only ones who have mentioned it.

The most frequent tissue found in these tumors is the proliferating connective tissue (Fig. 24. J). It really forms the stroma of the tumor, and in it the structures just enumerated are situated. There is a delicate fibrillated connective tissue as well, running in which are the small blood vessels which supply the growth. The sarcoma tissue is made up sometimes of round, sometimes of spindle cells, and in many instances both are present. In a series of sixty-seven cases analyzed by the writer, spindle cells were found seventeen times, round cells twenty-six times, and in twenty-four both were present. It was the occurrence of this form of stroma which gave rise to the opinion that these tumors must be sarcomata. The cells have a decidedly embryonic appearance and they are to be looked upon as of embryonic origin.

In many of the growths described, nothing is mentioned but spindle or round cells, and the growths so described have been called examples of pure sarcoma. It is very likely that, in many instances at least, insufficient examination has failed to find other elements which would have been discovered by a more thorough examination. It is not impossible, however, that a simple form of growth as just described may occur, and Ribbert[1] speaks about these tumors. He explains by saying that in a "theoretical sense they may be spoken of as mixed tumors," formed of only one kind of tissue. It is quite possible, however, that they may be examples of pure sarcoma. Some of them seem to originate in the kidney capsule, the usual seat of origin of sarcoma in the adult. Wagner[2] mentions such a case in a child three years of age, and so also does Steele[3] in a female child two years and eight months old. In Wagner's case the tumor is described as a "sarcoma originating in the

[1]Geschwülstlehre, Bonn, 1904, p. 602.
[2]Dtsch. Zeit. f. Chir., 1886, Vol. 24, p. 509.
[3]Medicine, 1895, Vol. 1, p. 14.

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kidney capsule," and in Steele's case as a "small spindle cell sarcoma, apparently originating in the kidney capsule."

The mixed tumors of the kidney sometimes reach a very large size. When once they begin to grow the increase is very rapid, and it is not unusual to see a tumor double in size within the course of a few weeks. Tumors the size of a child's head are not unusual, and they may be so large as to almost, if not quite, fill the abdominal cavity. Growths weighing six or seven pounds are not unusual and they have been reported as high as ten, twelve, and fourteen pounds.

The shape of the tumor may be smooth, or irregular and nodular. Usually the growth is free from irregularities, and is felt as a smooth mass underneath the abdominal walls. The consistence of the mass may be either firm or soft: firm if the tumor is a solid one; and soft if degenerative changes have taken place within it. The older tumors are apt to be more friable than the more recent ones, and they may be easily broken.

On section the tumor is grayish white or yellow in color, and if hemorrhage has taken place the darker colors may be seen. If there is much edema within the tissues of the growth a fluid exudes when the tumor is cut. In some instances cyst formation occurs, and these cysts are the result of previous hemorrhage or of degenerative changes. Softening of the tumor is sometimes due to a myxomatous change, and this gives to the growth a soft, jelly-like consistence. This myxomatous degeneration is due to a modification of the stroma of the tumor.

The mixed tumors almost invariably arise in the substance of the kidney. The growth takes place directly in the parenchyma, but it does not infiltrate the kidney tissue as an ordinary malignant growth usually does.

Occasionally the growth extends toward the renal pelvis, and in these cases the pelvis becomes involved and the tumor masses may be seen projecting as excrescences or polypi on

the pelvic wall. In rare instances even the ureter has been attacked by the growth and shows as a thickened cord. Ribbert[1] has reported a case of mixed tumor in which the ureter became occluded, with resulting hydronephrosis. A cyst was formed in consequence of the accumulated urine. On the walls of this cyst, projecting into its cavity, there were numerous papillary tumor masses. The pelvic involvment is not at all usual and but few cases have been reported.

The rhabdomyoma and the mixed tumors present certain features which are common to both. They are as follows: Both the tumors grow in an expansive way. There is no real infiltration of the surrounding kidney structure, as already stated, but rather the kidney tissue is pushed aside by the growing mass, and the kidney is in consequence either flattened or spread out; in some cases it appears as a sort of excrescence on the top of the tumor itself. The compressed renal tissue suffers changes in the nature of atrophy. The glomeruli and tubules are compressed and appear much smaller than they are in a normal condition. That part of the kidney, which is not subject to the pressure, functionates in the normal way and urine is secreted. Obstruction of the ureter is of exceptional occurrence, probably because hemorrhage is relatively infrequent; this is in sharp contrast to the rather frequent hemorrhages which are seen in other forms of renal growths in adults.

Surrounding the tumor is a sort of a capsule, which is not a real one, but is rather of a spurious nature and is formed partly by the kidney capsule and partly by the renal tissue itself. Inflammatory changes in consequence of pressure likewise lead to the formation of a connective tissue, and this further serves to increase the size of the capsule.

Invasion of the renal vein by the growth has been mentioned in a number of instances, and thrombi are formed which may extend into the vena cava. Loosened emboli

[1]Virch. Arch., 1886, Vol. 106, p. 282.

may find their way to the heart and lungs, and may cause sudden death or lead to the extension of the disease by metastasis. Extension into the veins, however, is not nearly so frequent as it is in the case of kidney tumors in the adult.

The tumor as it grows displaces neighboring organs, such as the stomach, spleen, and liver, and large tumors may press the diaphragm upwards even as high as the fourth rib.

Metastases of these growths are relatively infrequent. The tumor is essentially a local growth and is not apt to extend even to the surrounding tissues. Exceptionally, however, this does occur and the growth may attack, for instance, the bowel or some other contiguous organ.

The lymphatic system is almost never invaded, and Birch-Hirschfeld[1] asserts that no rhabdomyoma has yet been found with metastases in the lymphatic glands. In the case of the mixed tumors, however, the glands are sometimes, though very infrequently, invaded.

Walker[2] in an analysis of one hundred and forty-two cases of mixed tumors found fifty-five cases in which there were metastases.

Liver and Lungs	11
Opposite kidney	11
Retroperitoneal glands	10
Mesenteric glands	6
Vena cava	6
Pleura	3
Liver	4
Portal vein	1
Diaphragm	1
Scrotum	1
Bladder	1

Walker also states that in a few instances the colon, adrenals, and small intestines were invaded by continuity.

The writer found metastases to occur in about twenty-one per cent. of the cases. The organs attacked were the following:

[1]Zeigler, Beitr., 1898, Vol. 24, p. 357.
[2]Ann. Surg., 1897, Vol. 26 p. 554.

Liver	7
Lungs	9
Peritoneum	5
Dura mater	1
Scrotum	1
Iliac fossa	1
Vena cava	2
Axiliary glands	1
Bowel	2
Retroperitoneal glands	2
Mediastinal glands	1
Mesentery	1

Floriken's[1] case, in which there were metastases in the dura mater, is quite unique. It was a case of a boy five years old, who had a large tumor in the left kidney, the size of a child's head. There were metastases in the dura mater in that part bordering on the frontal and parietal regions. The structure of this tumor was that of a spindle cell sarcoma, and there were likewise scattered about in its stroma many tubular structures which were lined with cylindrical cells.

The smaller growths are not apt to give metastases at all, and usually it is only when the growth is of a large size and has broken through the capsule that metastasis may take place.

PATHOGENESIS

The pathogenesis of rhabdomyoma and the mixed tumors is undoubtedly the same, for the features of both are very similar.

The first attempt at explaining the origin of these growths was made by Eberth[2]. Eberth was struck with the peculiar embryonic look of the tissue and he tried to explain the muscular elements by supposing that in some way in embryonic life, portions of the Wolffian body became included in the kidney, and subsequently developed in it.

After Eberth, Cohnheim[3] thought that the striated mus

[1]Beitr. z. klin. Chir., 1906-07, Vol. 52, p. 732.
[2]Virch. Arch., 1872, Vol. 55, p. 520.
[3]Virch. Arch., 1875, Vol. 65, p. 68.

cle in the rhabdomyoma might originate from the primitive. vertebrae, from which a considerable part of the musculature of the body is derived, and he thought that some of the muscle cells might become mixed with the first anlage of the kidney and develop in the permanent kidney. He called attention to the fact that the first anlage of the urogenital tract lies in the direct vicinity of the primitive vertebrae.

Birch-Hirschfeld[1] called attention to Eberth's theory of the origin of the growths, and he was inclined to agree with this pathogenesis. In a subsequent article[2] he definitely, for the first time, collected these tumors in a single class, and he showed that they must, from the great similarity which marked them, all belong to one special class, with a single pathogenesis. He called attention to the typical groundwork of the tumors and to the mixture of glandular and archiblastic constituents which, in form and arrangement, recalled embryonic tissue in active proliferation. Birch-Hirschfeld first gave to the growths the name "embryonic adenosarcoma." He called attention to the great difference between these tumors and true carcinoma, which has origin in epithelial cells, and it was evident to him that they could not be carcinomata on account of their sarcomatous constituents. The behavior of the tumor was unlike that of carcinoma, and there was also an absence of glandular involvement, which characterizes the typical carcinoma. As to pathogenesis, Birch-Hirschfeld[3] agreed in the main with Eberth, who derived these tumors from inclusions of the Wolffian body. The origin of the tumor from the remains of the Wolffian body would explain, he thought, both the close relationship of the tumor to the kidney and the renal pelvis, and also the absence of a true intermingling of the tumor tissue and the renal tissue, in the sense of a transition between the elements of the two.

[1]Centr. f. d. Krank. der Harn und Sex.-Org., 1894, Vol. 5, p. 97.
[2]Zeigler. Beitr., 1898, Vol. 24, p. 243.
[3]Loc. cit., p. 361.

Willms[1] in his well-known monograph on mixed tumors, went a step further. He derived these tumors from primitive islets of embryonic tissue in the first stage of development. He derived the striated muscle from the myotome; connective tissue, fat, and cellular tissue, from the mesenchyma, and the tubular structures from the Wolffian body.

Muus[2] believed that the origin of these tumors could be sought in the kidney itself, and he based this opinion on the fact that, in the embryonic kidney, structures were found very similar to those found in the tumor. Muus thought that at an early period in fetal life an isolated portion of the kidney anlage took on a pathologic growth instead of a normal. The embryonic type was thereafter maintained unchanged and he thought the different elements proliferated excessively and irregularly. The other parts of the kidney anlage developed normally. He thought that the fat and cartilage were formed by metaplasia of the connective tissue; that myxomatous tissue was merely a modification of the connective tissue; the striped muscle he believed to be derived from proliferation of the mesodermal cells in the earliest period of the kidney anlage, at which time not only the different connective tissue modifications, but also muscle might be formed by excessive proliferation. The epithelial formations he believed to be derived not from the primitive kidney, but from the kidney anlage itself.

Herzog[3] explained these tumors in the following way: "To give our views as to the pathogenesis of these tumors, it is necessary to enter, very briefly, into a discussion of the development of the myotome and of the Wolffian body (Fig. 29). These structures are developed from the early mesoderm, which is first differentiated into the myotome and the lateral plate. Between these structures there is formed a thin bridge known as the nephrotome; in the latter the transverse excretory tubules of the Wolffian body, emptying

[1] Mischgeschwülste, teipsic, 1899.
[2] Virch Arch., 1899, Vol. 155, p. 416.
[3] Am. Jour. Med. Sci., 1900, Vol. 119, n. s., p. 697.

later on into the Wolffian duct, are formed. While the tubules develop the nephrotome becomes entirely cut off from the myotome. This is, in short, the normal course of events. With reference to the embryonal adenosarcomata, we assume that they owe their origin to an inclusion which is formed in the following manner. The nephrotome is not cut off at the normal site, but in such a manner that a part of the myotome is severed from the main mass and remains in connection with the nephrotome. The separation may

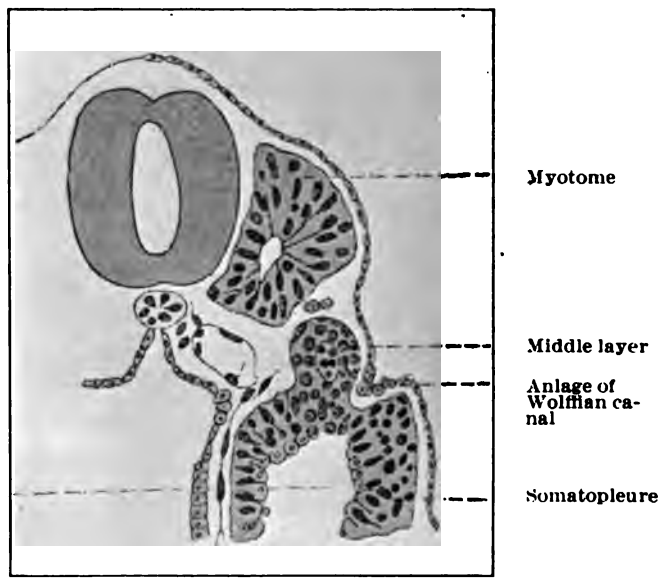

Fig. 29.—Transverse Section of the Human Embryo.
From Kollman (Albarran and Imbert; Les Tumers du Rein, Paris, 1903, p. 155).

take place so that only a part of the myotome proper is cut off, or a part of the sclerotome may likewise be taken along. If the former is the case, we have the matrix for striated muscle fibre only; if the latter occurs we have also the matrix for cartilage. If, now, we assume that a part of the nephrotome (Wolffian body) to which tissues of the myotome proper, or the latter and the sclerotome have become adherent by an abnormal process of embryonic separation, becomes included in the permanent kidney, we have a matrix

containing all those embryonic elements which occur in the mixed tumors of the kidney, namely striated muscle fibres, cartilage, other connective tissue elements, and epithelial glandular structures. The latter, of course, are derived from the excretory tubules of the nephrotome."

Jenckel[1] agreed in the main with Muus in deriving these tumors from the embryonic kidney. The origin of the smooth muscle fibre, according to Jenckel, was not difficult to explain, because it was seen everywhere in the embryonic kidney. He thought also that fat, cartilage, and even epithelial formations might have an origin in the embryonic kidney, in view of the origin of the kidney from the cells of the middle germinal layer. Jenckel was somewhat in doubt about the origin of the striated muscle and could not be sure whether the striped muscle should be explained by the hypothesis of metaplasia from smooth muscle, or whether Willms's view was correct.

Ribbert[2] believed that mixed tumors could arise only from cells which are isolated and still undifferentiated; that is to say, morphologically indifferent. Ribbert called attention to the fact that tumors of this class arise especially in the urogenital tract, namely, in the kidney, uterus, bladder, and vagina; this would seem to point to a common origin. Ribbert asked[3] whether it was not possible that all mixed tumors of the urogenital tract may not arise from *germinal cells* which have been isolated early in embryonic life. "It is only a short step from the anlage of the sexual glands to the neighboring kidney, and these might easily be taken up into the Mullerian or Wolffian duct. Whether the displacement of the germinal cells is active or passive may be disputed. I would assume that it is active. These cells, which have lost their organic connections, find their way into the kidney region and move downwards in both ducts. They may wander through the Mullerian ducts and remain on

[1]Dtsch. Zeit. f. Chir., 1901, Vol. 60, p. 514.
[2]Geschwülstelehre, Bonn, 1904, p. 604.
[3]Loc. cit., p. 641.

their inner surface, or, what is more probable, through the Wolffian duct and develop in the wall of the cervix or the vagina. We thus have a simple explanation for all of the mixed tumors of the urogenital tract and bring them into connection with the teratomata of the ovary and testicle."

Busse[1] rejected the theory of misplaced tissues and derived the tumors from the embryonic kidney. He derived the striated muscle from metaplasia of the smooth muscle, basing his opinion on the following grounds: (1) "large numbers of transition forms; (2) position and arrangement of striped fibrillae, which is not that of the somatic musculature, but that of unstriped muscle; (3) the occasional presence of striation in places where only smooth muscle is found; (4) the discovery in the pregnant uterus of striated fibres, this being explained upon the basis of a metaplasia of the highly developed involuntary muscle of the uterus in pregnancy." As for the other structures found in these tumors, he derived them from the embryonic kidney, and he called attention to the similarity of the tumor structures to structures in the embryonic kidney. In a later article[2] Busse reiterated his belief in regard to the origin of these tumors.

Carey[3] derived the tumors from metaplasia of the tissue of the embryonic kidney. Thus, sarcoma-like tissue is derived from round cells, epithelial tissues from the interstitial tussue; mucoid tissue, cartilage, and fat from the connective tissue; smooth muscle fibre from that normally found in the kidney; and striated muscle fibre from metaplasia of the smooth fibre.

Bland-Sutton[4] rejected an extrarenal origin for these growths and stated that a study of the fetal kidney demonstrated very clearly that these growths arise in the connective tissue of the renal sinus. "The tubular structures are due

[1]Virch. Arch., 1899, Vol. 157, p. 370.
[2]Verh. der Dtsch. Path. Gessel., 1904-05, 7-9, p. 68.
[3]Alb. Med. Ann., 1907, Vol. 28, p. 151.
[4]Tumors, Innocent and Malignant, London 1907 p. 105.

to entanglement of the uriniferous tubules in consequence of the sarcoma invading the cortex, while the striated muscle is derived from the muscle tissue of the renal pelvis, which is an expansion of the hollow muscle known as the ureter."

It is evident from a perusal of these various views in regard to the pathogenesis of these tumors, that there is no uniformity of opinion. It will be seen that there are three theories which have been evolved. The first is the theory that the tumors are derived from the Wolffian body; the second that they are derived from the embryonic kidney; the third, that they are derived from aberrant cells of the myotome, or other similar structures.

The theory that the tumor is derived from the Wolffian body has been largely discountenanced. There is nothing to show that the Wolffian body furnishes abnormal aberrant tissues, for these aberrant islets have never been found in the kidney or elsewhere, although the structure is easily recognized. Furthermore, the Wolffian body cannot give rise to striated muscle fibre.

The fact that these tumors are so frequently found either at the time of birth or shortly after birth, or even in fetal life, shows that their origin must be intimately associated with early tissue changes. It is probable that tumors growing in childhood and first recognized at the age of three or four years, may have been latent in the kidney for a considerable length of time. The tumors growing in adults, although they are of extreme rarity, are more difficult to explain. Their precisely similar microscopic structure would seem to demand a similar origin, but yet it is difficult to imagine a latency which has extended over a period of many years. Yet that such a latency does exist is proved by the case of Jenckel[1], that of a female thirty-four years old, who carried a tumor in the right kidney for a period of eight years without special inconvenience.

[1]Dtsch. Zeit. f. Chir., 1901, Vol. 60, p. 502.

It was removed, and the patient was well two years later. The microscopic examination of the tumor showed smooth muscle, cartilage, and tubular structures, and the growth had a distinct stroma of spindle and round cells. The long period of time during which the tumor was carried shows that the growth was not a rapidly growing one, and argues for a latency which might easily have extended over a long period of time before the growth was noticed.

Those who try to explain the growth on the supposition that it has originated from tissues in the embryonic kidney, have difficulty in explaining the presence of striated muscle. Ribbert[1] utterly rejected the theory that striated muscle is a result of metaplasia of smooth muscle fibre. The latter is a normal constituent of the kidney. Ribbert denied that there is any genetic relation between the two forms of fibre, and he believed that they are not connected in any way with each other, and that therefore any transition between the two must be excluded. Bland-Sutton and Busse were both strong supporters of the view that the tumor originated in structures already in the kidney. Jenckel was likewise strong in this view, and he thought that he could prove that the origin of the tubular structures was from the embryonic kidney. He referred[2] to a case of a male epileptic, fifty years of age, who had what Jenckel considered to be a "representative of an embryonic kidney, which remained stationary at a certain stage of development." This rudimentary kidney corresponded to the first or second month of embryonic development and was composed of "a mass of cellular connective tissue interwoven with smooth muscle elastic fibres and numerous tubular structures very similar to those seen in a large mixed tumor. There were no glomeruli, and there was no transition between the glandular formations and the renal pelvis." The strongest supporter of the view that the tumor is derived from kidney elements al-

[1]Geschwülstelehre, Bonn, 1904, p. 294.
[2]Dtsch. Zeit. f. Chir., 1901, Vol. 60, p. 519.

ready present was Bland-Sutton, but he merely states his opinion without giving any arguments for or against.

The theory that the growth is due to inclusions of the myotome and similar structures is the one which has been most supported. Willms was the originator of the theory, but the difficulty in accepting Willms' views comes from the fact that it presupposes too many possibilities. He derives the tissues from the myotome, from the mesenchyma, and from the Wilffian body. Herzog was likewise a strong supporter of the view that the nephrotome had much to do with the origin of the tumor. Ribbert's view appears to be plausible, and it certainly would seem to explain all the mixed tumors of the urogenital tract.

ETIOLOGY

Embryonic tumors of the kidney are especially common in infancy and childhood. Albarran and Imbert[1] found 416 cases of usual renal tumor in the adult and seventy-three embryonic tumors in childhood.

Walker[2], in a list of one hundred and thirty cases in which sex was mentioned, found fifty-five in males, fifty-one in females, and in twenty-four the sex was not stated. Albarran and Imbert[3] found eighty in males and fifty-five in females. In the writer's tables there were fifty males, forty-five females, and in five the sex was not stated.

The age at which these tumors appear may be seen by a glance at the following tables. Albarran and Imbert's[4] is as follows:

From	0	to	3	years	89 cases
"	4	"	6	"	42 "
"	7	"	9	"	21 "
"	10	"	12	"	7 "
"	13	"	15	"	6 "

[1]Les Tumeurs du Rein, Paris, 1903, p. 411.
[2]Ann. Surg., 1879, Vol. 26, p. 559.
[3]Loc. cit., p. 414.
[4]Loc. cit., p. 412.

Steffen's[1] list is as follows:

	Male.	*Female.*	*Not stated.*
Still-born 2	—	—	—
Under 1 year 34	9	10	15
1 year. 15	5	7	3
1 1-2 years 17	4	8	5
2 years 23	7	9	7
2 1-2 years 11	6	4	1
3 years 31	11	16	4
4 " 22	9	10	3
5 " 15	5	10	0
6 " 15	6	9	0
7 " 7	3	3	1
8 " 7	2	4	1
9 " 4	4	0	0
10 " 2	1	0	1
11 " 4	1	3	0
13 " 2	1	1	0
15 " 1	0	1	0
16 " 1	0	1	0

The writer's list is as follows:

0 to 1 year	10
1 " 2 "	21
2 " 3 "	16
3 " 4 "	13
4 " 5 "	11
5 " 6 "	12
6 " 7 "	3
7 " 8 "	3
8 " 9 "	3
9 " 10 "	2
10 " 11 "	1
11 " 12 "	1
13 " 14 "	1
18 " 19 "	1
30 " 40 "	2
40 " 50 "	1
50 " 60 "	1
Not stated	1
Total	100

[1]Die malignen Geschwülste im Kindesalte, Stuttgart, 1905, p. 28.

The adult cases referred to in the above table were: Busse's[1], in a female fifty-seven years old; Hoisholt's[2], in a male eighteen years old; Jenckel's[3] in a female forty-three years old; Kocher and Langhans'[4], in a female thirty-five years old; and Muus'[5], in a female thirty-four years old.

These adult cases show conclusively that the disease is not confined to the period of childhood and infancy.

In one hundred cases analyzed by the writer, the tumor affected the left side in forty-one instances, the right in thirty-seven, both sides were affected in six, and in sixteen there was no mention made as to the side affected.

In Albarran and Imbert's[6] list of one hundred and thirty-eight tumors, both sides were affected four times, the left, sixty-nine times, and the right sixty-five times.

In Walker's[7] one hundred and forty-one cases, the left side was affected seventy-three times, the right fifty-eight times, and the disease was bilateral in ten instances.

The bilateral cases are interesting, and of course the question arises as to whether the disease did not start in one kidney and later attack the second one by metastasis. Judging from the rarity of metastases in this disease, it seems more likely that both kidneys were attacked independently, but there is no proof that this is so.

Trauma has been mentioned by Walker[8] as an exciting cause of the growth thirty times in one hundred and forty-two cases. It is probable, in view of the probable pathogenesis of the disease, that trauma by itself has nothing to do with the causation of the growth, but a blow may well start up to active growth a tumor which has previously been latent. Heredity may predispose to the disease and Albar-

[1]Virch. Archiv., 1899, Vol. 157, p. 352.
[2]Virch. Arch., 1886, Vol. 104, p. 118.
[3]Dtsch. Zeit. f. Chir., 1901, Vol. 60. p. 502.
[4]Dtsch. Zeit. f. Chir., 1878, Vol. 9, p. 312.
[5]Virch. Arch., 1899, Vol. 155, p. 406; Marchand: Berl. klin. Woch., 1895, Vol. 32, p. 924.
[6]Les Tumeurs du Rein, Paris, 1903, p. 415.
[7]Ann. Surg., 1907, Vol. 26, p. 570.
[8]Ann. Surg., 1897, Vol. 26, p. 541.

ran and Imbert[1] mention that it was noted five times in one hundred and seventy-three of their cases. In the writer's list of one hundred cases it was mentioned once as a possible predisposing cause of the disease.

SYMPTOMS

In a great majority of the cases, subjective symptoms are entirely absent in the first part of the disease. The patient may have apparently perfect health, and yet there may be an abdominal tumor which is rapidly growing. Frequently the growth is not discovered nor appreciated at all until it has become well started, and instances have been reported in which a comparatively large tumor escaped observation until just a few days or a few weeks before the nephrectomy was performed. Occasionally symptoms of emaciation and gradual decline lead to a thorough physical examination of the child, and a tumor is found in one or the other hypochondriac region. Pain is but rarely the first symptom of the disease, and the same is true of hematuria. Occasionally the disease is ushered in by a gastrointestinal attack, with vomiting and diarrhea. The disease has been ushered in by convulsion, with temporary anuria, which was followed by an attack of hematuria. An unusual onset is by dyspnea, severe coughing, and sleeplessness.

By far the most prominent feature of the disease is tumor. As an initial symptom it was found by Albarran and Imbert[2] in seventy-one per cent. of the cases. In the beginning of the disease the tumor appears under the ribs in the region of the kidney, and it may be smooth or nodular in outline. It is easily palpated, and as a rule is not sensitive to pressure unless there is some inflammatory reaction in its vicinity. It is not unusual for the growth to enlarge with great rapidity, especially after it has reached an appreciable size. It may rapidly extend to the median line of the

[1]Loc. cit., p. 416.
[2]Loc. cit., p. 421.

body, and may even fill the entire abdominal cavity. The growth is not influenced by respiratory movements. Walker[1] in twenty-seven out of one hundred and forty-two cases, found that the colon passed over the tumor and was adherent to it. Walker notes that the colon probably had this position in a much larger number of cases. Semi-fluctuation has been obtained in a number of instances, even in those growths which contained no cysts. This feeling is probably due to the occasionally soft character of the growth. On percussion a dull note is obtained, except over the part which is occupied by the intestine.

Pressure symptoms are very common, and they are due to the large size of the tumor, which encroaches upon the neighboring organs. Edema of the legs has been remarked in a number of cases, and accumulations of fluid in the abdomen are not infrequent. The explanation of these phenomena, of course, is to be sought in the pressure of the tumor upon the blood vessels in the vicinity. It is not unusual to observe enlargement of the veins coursing over the abdominal wall, and this collateral circulation is to be explained by the pressure of the growth on the large blood vessels, within the abdomen, which impedes the passage of blood through them. In some instances separation of the recti may occur as the result of pressure of a large sized tumor. Dyspnea cyanosis and edema of the lungs are likewise symptoms of considerable importance. A tumor on the left side of the body pressing upwards may displace the diaphragm, and with it the heart. A tumor on the right side may compress the bile duct and give rise to intense jaundice. Neuralgia of great severity, affecting the intercostal nerves and branches of the lumbar plexus, may also occur. Occasionally a tumor of large size in a very young patient may cause deviation of the spinal column.

Pain is not a prominent symptom in this form of tumor.

[1]Loc. cit., p. 543.

Imbert[1] found pain the initial symptom in twenty per cent. of the cases. The writer found it the initial symptom in seven per cent. of the cases, and it was present during some stage of the disease in twenty per cent.; in nine per cent. it was distinctly mentioned that pain was not present at any time during the course of the disease.

The pain is dull and heavy, and is apt to be continuous; when it is due to blocking of the ureter by a blood clot, it takes the character of severe colic and occasions much suffering.

Imbert[2] found hematuria as the initial symptom in five per cent. of the cases, figures which correspond almost exactly with those of the writer, who found the symptom mentioned as the first one in the disease in six per cent. of the cases. Albarran and Imbert[3] found the symptom present at some time during the disease in sixteen per cent. of the cases. Hematuria, therefore, is not a prominent symptom of embryonic tumors, and this is in contrast with the much greater frequency in other forms of tumors occurring in the adult. When it does occur, the amount of blood lost is not usually abundant. A single attack of hematuria may mark the onset of the disease, and there may be no more bleeding until death occurs. Occasionally the attacks come on at intervals of a few weeks and soon subside; the patient may not have more than two or three attacks during the course of the disease.

The urine is not usually altered, and that secreted is, as a rule, normal in amount and in solid constituents. Occasionally it is diminished to an appreciable extent, but this seldom happens. Anuria almost never occurs. It has been supposed that this anuria is caused by compression of the ureter of the opposite kidney; another explanation is that the phenomenon is reflex in character. In rare cases albuminuria has been noted.

[1]Gaz. d. Hôp., Paris, 1903, Vol. 76, p. 631.
[2]Gaz. d. Hôp., Paris, 1903, Vol. 76, p. 631.
[3]Loc. cit., p. 425.

Symptoms on the part of the bladder are very rare. Frequent micturition, reflex in character, or due to blood clots in the bladder, may occur. Incontinence has been reported a few times, and also retention of urine. In these cases the explanation is probably to be sought in some disturbance of the nervous system.

The general symptoms of the disease are those usually seen in malignant affections. When the tumor has gotten well under way, emaciation may be quite rapid and loss of strength, anorexia, and general weakness are apparent. The gastrointestinal tract is very apt to suffer, and vomiting and diarrhea are occasionally present. Fever of a hectic type has been reported in a number of instances, and this serves to hasten the end. Sleep is very apt to be disturbed, and this sleeplessness has occasionally been remarked in the first part of the disease. Reflex symptoms may be noted, such as headaches, cough, dyspnea, orthopnea, and a peculiar choreiform twitching of the muscles. Osler[1] reports a case in which death was caused by a convulsive fit of choking. These tumors are exceedingly malignant and frequently end life within a very short period of time. The minute histologic structure of the tumor appears to have no special influence in regard to malignancy, and the writer found that when the stroma was composed of spindle or round cells the disease ended equally rapidly. These tumors are among the most malignant of any type of tumor. The following table shows the duration of the disease from beginning to end, without nephrectomy. The time mentioned means simply the time during which the patient suffered from appreciable symptoms.

1 month or less	1
2 months	1
3 "	6
4 "	3
5 "	2
7 "	5

[1]Jour. Anat. and Phys., 1879, Vol. 14, p. 230.

8 "	1
9 "	2
1 year	2
2 years	1
Total	24

The extreme malignancy of the disease is shown by the following table, which gives the duration of the disease from the beginning to the end, nephrectomy intervening. These patients did not die immediately after the operation was performed.

1 month or less	4
2 months	3
3 "	2
6 "	2
7 "	5
8 "	1
9 "	1
10 "	1
1 year	4
2 years	1
Total	24

Ordinarily the cause of death is cachexia. The patient gradually fails, and dies of exhaustion. Occasionally some intercurrent disease carries off the patient. Uremia is sometimes the cause of death, but this rarely occurs. As metastases are relatively infrequent, death is seldom caused as a result of extension of the disease in some other organ of the body; but this occasionally does occur, and in these cases death is hastened.

DIAGNOSIS

A rapidly growing tumor in the lumbar region of a child, with symptoms of emaciation and cachexia, especially if hematuria has occurred at some time during the course of the disease, usually means tumor of the kidney. In the absence of hematuria, a rapidly growing mass may easily be

malignant disease of the retroperitoneal glands. In the latter affection the differentiation is aided by noting the position of the growth. Tumor of the kidney has a lateral position, while the glandular growth is centrally located and it has a zone of sonority around it. A restless child who will not readily submit to examination had better be etherized so that the physical examination may be thorough.

An early hematuria without tumor is exceedingly difficult to diagnose correctly. Here the examination of the urine is occasionally of great assistance. Occasionally it will be possible to separate the urine intravesically by means of a small sized Luys' separator. In certain diatheses crystals are found in the urine, which may very exceptionally irritate the kidney to such an extent as to cause a severe attack of hematuria. Proper treatment will usually cause the symptoms to disappear. At the same time it should be remembered that hematuria, without an appreciable tumor, occasionally occurs, and in such a case the greatest precaution should be taken that a tumor may not escape observation through carelessness in neglecting to make sufficiently frequent examinations.

The hematuria of acute nephritis subsequent to infectious diseases should be borne in mind, but in these cases a thorough examination of the urine will easily clear up the diagnosis.

Renal tuberculosis in the child is of very rare occurrence, but its existence should be thought of. The usual tests for isolating the bacilli will make the diagnosis plain.

Tumors of the bladder in children are extremely rare, but they should be borne in mind. Cystoscopy is not always possible, but local symptoms with disturbances of micturition point to the site of the trouble. In a case in which there is tumor of the kidney without other symptoms, a diagnosis may long remain obscure.

Splenic enlargement due to malaria, leukemia and syphilis will have to be differentiated. It is well to remember

that the anterior border of the spleen is sharp, and that there is no zone of tympany between the tumor and the spinal column, and that the colon does not pass in front of the spleen. An examination of the blood will frequently lead to a correct diagnosis.

Hydronephrosis is very rare in children. It develops slowly and does not reach the large size of renal growths. It is occasionally accompanied by colic, and sudden changes in the size of the tumor may take place.

Ovarian tumors are so rare in children that they may be practically disregarded, and the same is true of echinococcus.

Tumors of the liver are very rare in children. In such cases jaundice is apt to be present, but here one must be on the lookout that a tumor under the ribs, accompanied by jaundice, is not a renal growth which has compressed the bile duct. Liver enlargements do not give ballottment, and the anterior border of the liver is quite marked and extends in a lateral line across the abdomen. Tubercular peritonitis in the child is not of great rarity, and is sometimes quite difficult to differentiate. The presence of fever is not a differentiating feature, because it is sometimes seen with tumors in the kidney. The presence of fluid in the abdomen is possible with both diseases and it is at times impossible to differentiate the two. The family history may be of assistance here, and so likewise is the occurrence of tubercular foci in some other part of the body.

TREATMENT

Some years ago operation was not performed for tumors of the kidney in children, because the operative mortality was so great and the risk of recurrence so considerable. In later years, with a better and earlier selection of cases, the mortality of the operation has been very much reduced.

A condition of general weakness is a decided bar to con-

templated operation; so likewise is the presence of metastases in other parts of the body. The opposite kidney should be examined with the greatest care, for, as we have seen, bilateral involvement is not so unusual that it can be totally disregarded. A small tumor, of course, offers the best chance for thorough removal, and in view of the local character of the disease it would seem as though small tumors offer less chance for recurrence than larger ones. Nevertheless, large tumors have been removed and the results have been gratifying. For instance, Abbe[1] removed a large tumor weighing seven and one-half pounds from a female infant a year and a half old, and the patient survived the operation and was well one year later. There is great danger that the tumor may be inoperable because the family have waited too long before making up their minds to have the operation performed. The relatively mild symptoms in many of the cases are occasionally an inducement with timid people, to delay an operation which is manifestly urgent.

With small tumors the lumbar extraperitoneal incision will be selected, and if possible the peritoneal cavity will not be opened. Nowadays, however, with improved technique, there is not so much risk in opening the abdominal cavity and this route does not offer more risk than the lumbar. Albarran and Imbert[2] in a list of twenty-four cases operated upon by the lumbar incision, noted seven deaths, or twenty-nine per cent., while in seventy-six cases operated upon by the abdominal route there were twenty deaths, or twenty-six per cent. These authors state that the high mortality by the lumbar route was probably due to the fact that an attempt was made to remove tumors of considerable size through an extraperitoneal incision; in such cases the operation is unusually difficult.

If the abdominal route is selected, that incision should

[1]Ann. Surg., 1894, Vol. 19, p. 61.
[2]Les Tumeurs du Rein, Paris, 1903, p. 444.

be given which will give the most room. An incision beginning a short distance from the spinal column, parallel with the rib and a little below it, and extending towards the median line, will usually give sufficient room. Many operators prefer the vertical Langenbuch incision, believing that there is less danger of permanently damaging the muscles than if the transverse incision is used. The Trendelenburg posture is sometimes of great assistance in exposing the field, and it is also of service because it keeps the blood in the region of the vital organs of the body during the operation; this is of considerable importance if there happens to be a hemorrhage during the course of the operation, an event which is not unlikely to happen if the tumor is very vascular and has large blood vessels. Great care should be exercised to avoid loss of blood, and clamps should be freely used. These clamps may be left on, if necessary, until clotting has taken place, and they may be removed in from two to five days after the operation.

The patient should be well stimulated after the operation has been completed, and the best method is by means of saline infusion and brandy and coffee injections by rectum. An inclined position should be maintained until the operative shock has passed.

The immediate mortality of the operation some years ago, according to Döderlein and Birch-Hirschfeld[1] was forty per cent., and these authors stated that death, in most of the cases, was due to shock, peritonitis, and hemorrhage. Walker[2] gave a mortality of thirty-six per cent. in seventy-four operative cases. Albarran and Imbert[3] found that the mortality is progressively less the later the statistics. Their table, which is as follows, shows this very clearly.

From	1876	to	1890,	34	cases with	18	deaths, or 52 per cent.
"	1890	"	1895,	32	" "	7	" " 21 "
"	1895	"	1902,	90	" "	23	" " 25 "

[1]Centr. f. d. Krank. der Harn und Sex.-Org., 1894, Vol. 5, p. 13.
[2]Ann. Surg., 1897, Vol. 26, p. 585.
[3]Les Tumeurs du Rein, Paris, 1903, p. 443.

It is surprising how well little babies stand a severe operation of this kind, even if they have lost a considerable amount of blood. An incomplete operation, however, is very fatal, most of the patients dying almost immediately. Large tumors are difficult to remove, especially in the presence of adhesions. Albarran and Imbert[1] in a list of forty-one cases in which the age was two years and under, found five operative deaths and thirty-six recoveries.

The disease is very apt to recur, even after a most thorough operation, the recurrence taking place within a very short period of time. In most of the cases reported, death has been due to recurrence; in some, an intervening complicating disease has carried the patient away. Walker[2] gives six months as the average length of time intervening between the operation and recurrence, when it does take place. Albarran and Imbert[3] in a list of forty-two cases found recurrence occurring as follows:

Six months	29
Six months to a year	10
Three and a half years	1
Four years	1
Five years	1
Total	42

In the writer's tables, practically the same results were obtained, as is shown by these figures.

One month or less	2
Two months	5
Three months	5
Four months	3
Five months	0
Six months	2
One year	1
Total	18

[1]Loc. cit., p. 444.
[2]Ann. Surg., 1897, Vol. 26, p. 586.
[3]Loc. cit., p. 446.

Albarran and Imbert,[1] in a list of ninety-two survivals of the operation, state that eighty-one per cent. of them suffered a recurrence, and they state that the general mortality, which includes death from operation and death subsequently, is in the vicinity of eighty-six per cent. Walker[2] places it still higher, 93.22 per cent.

In estimating the number of actual cures following the operation, it is well to remember that recurrence may occur even a considerable length of time after the operation has been performed.

It is very difficult to estimate the total number of cures from recorded figures, because end results in cases of survival have not, in the majority of instances, been given. The following are the only two well authenticated cases that have been reported as surviving after three years: Schmid's[3] case, in a male six months old, who survived the operation three years and was still well; Muus's[4] case, in a male nine months old, who survived nephrectomy and was well three years afterwards. Other cases to the number of four or five reported as survivals of three or more years' duration, by various authors, were found, on investigation by the writer, to be instances of hypernephroma.

Albarran and Imbert[5] have estimated positive cures at twelve per cent., but they have based this opinion, not on actual survivals, but on the probable outcome of survivals in which recovery from the operation took place, and which were reported as "cures" of a few months' to two or three years' duration, most of them being survivals of a few months' time.

[1]Loc. cit., p. 445.
[2]Loc. cit., p. 585.
[3]Centr. f. Chir., 1895, Vol. 20, p. 672.
[4]Virch. Arch., 1899, Vol. 155, p. 408.
[5]Les Tumeurs du Rein, Paris, 1903, p. 448.

CASES OF EMBRYONIC TUMORS

No.	Name and Reference	Sex	Age	Duration Before Operation	Duration of Disease up to time of Death	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result	Histologic Structure
1	Abbe; Ann. Surg. 1894., Vol. 19, p. 61	Female	1 yr. 2 mos.	Six weeks	Not stated	Right	Six weeks	Slight	Not stated	None	Nephrectomy	Not stated	Recovery	Well 1 yr. later	"Rhabdomyosarcoma." Tumor contained striated muscle fiber and round and spindle cells
2	Abbe; Ann. Surg., 1894, Vol. 19, p. 58	Female	2 yrs.	5 mos.		Right	5 mos.	Not stated	Not stated	Diarrhea	Nephrectomy	None	Recovery	Well a yr. and a half later	Many tubular structures Irregular patches of cells. Connective tissue rich in cells
3	Allsberg: Dtsch. Med. Woch., 1887, Vol. 13, p. 873	Female	5 yrs.	Over four months	7 mos.	Not stated	4 mos.	Not stated	Initial symptom. Tumor 4 mos. later		Nephrectomy	Liver and Lungs	Recovery	Died 11 wks. after operation	Tumor was composed of spindle and round cells: no other structures mentioned
4	Baginsky: Berl. klin. Woch., 1876, vol. 13, p. 249	Not stated	7 mos.	Not stated	Not stated	Left	Yes	Not stated	Yes; intermittent		Tumor punctured	Not stated	Died immediately		Tumor composed of spindle cells
5	Barth: Dtsch. Med. Woch., 1892, vol. 18, p. 531	Female	5 yrs.	3 mos.	7 mos.	Not stated	3 mos.	Not stated	Hematuria a few times		Nephrectomy	Yes	Recovery	Died 4 mos. later from metastases	"There was an alveolar arrangement (tubular?)"
6	Bean: Northwest Medicine, Seattle, 1903, vol. 1, p. 14	Female	1 yr. 3 mos.	5 mos.		Left	5 mos.	Not stated	Not stated		Nephrectomy	None	Recovery	Not stated	"Small round cell sarcoma"

CASES OF EMBRYONIC TUMORS. (Continued)

No.	Name and Reference	Sex	Age	Duration Before Operation	Duration of Disease up to time of Death	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result	Histologic Structure
7	Birch-Hirschfeld: Zeigler Beitr., 1898, vol. 24, p. 343	Female	7 yrs.	Not stated	Not stated	Not stated	Yes	Not stated	Not stated		Not stated	Not stated	Death		Elongated tubules. Intercellular tissue made up of round cells. Smooth muscle
8	Birch-Hirschfeld: Zeigler Beitr., 1898, vol. 24, p. 351	Male	4 yrs.	6 wks.	6 wks.	Left	6 wks.	Not stated	Not stated		Nephrectomy	None	Death		Small cysts. Tubular structures. Striated muscle. Spindle cell stroma
9	Blumer: Albany Med. Ann., 1903, vol. 24, p. 444	Male	4 yrs. 6 mos.	6 mos.	9 mos.	Not stated	Yes; 6 mos. after hematuria	Not stated	Yes; 6 mos. before operation-initial symptom		Nephrectomy		Recovery	Died 3 mos. after operation	Stroma consists of spindle shaped cells. Tubular structures
10	Brock: Virch. Arch., 1895, vol. 140, p. 493	Male	3 yrs. 6 mos.	5 weeks	3 mos.	Right	Yes; 5 wks.	Not stated	Not stated			Non		Died 3 mos. after first symptom	Tubular structures. Striated muscle
11	Brosin: Virch. Arch., 1884, vol. 96, p. 453	Male	3 yrs.	2 yrs.	2 yrs.	Left	1 yr.	Not stated	Not stated			None		Died 2 yrs. after the first symptom	Stroma made up of spindle cells. Striated muscle in bundles. Tubular structures. Hyaline cartilage
12	Brünig: Münch. Med. Woch., 1904, vol. 51, p. 1274	Male	5 yrs.	2 wks.		Right	2 wks.	First symptom	Not stated		Nephrectomy	None	Recovery	Not stated	"Small round cell sarcoma." No other structures mentioned

CASES OF EMBRYONIC TUMORS. (Continued)

No.	Name and Reference	Sex	Age	Duration Before Operation	Duration of Disease up to time of Death	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result	Histologic Structure
13	Busse: Virch. Arch., 1899, vol. 157, p. 367	Male	6 yrs.	A few mos.	A few mos.	Left	A few mos.	Yes; the initial symptom	Not stated		Nephrectomy	None	Recovery	Died six weeks after operation	Sarcomatous connective tissue. Tubular structures. Myxomatous tissue. Smooth and striated muscle. Solid epithelial cell nests
14	Busse: Virch. Arch., 1899, vol. 157, p. 365	Male	4 yrs.	3 mos.	7 mos.	Left	2 wks.	Initial symptom	Not stated		Nephrectomy		Recovery	Died 4 mos. after operation	Striated muscle. Cysts. Epithelial cell nests. Smooth muscle
15	Busse: Virch. Arch., 1899, vol. 157, p. 361	Female	3 yrs.	2 yrs. 6 mos.	Not stated	Right	2 yrs. 6 mos.	Not stated	Not stated		Nephrectomy		Recovery	Not stated	Stroma has sarcomatous appearance. Myxomatous tissue. Epithelial cell nests
16	Busse: Virch. Arch., 1899, vol. 157, p. 356	Male	5 yrs.	1 mo.	3 mos.	Left	1 mo.	Not stated	Twice		Nephrectomy	None	Recovery	Died 2 mos. after operation	Smooth muscle. Striated muscle. Hyaline cartilage. Connective tissue proliferated and myxomatous in places. Tubular structures
17	Busse: Virch. Arch., 1899, vol. 157, p. 352	Female	57	1 yr.	1 yr.	Not stated	1 yr.	Not stated	Not stated		Nephrectomy	None	Death		Stroma of round cells. Striated muscle. Smooth muscle
18	Bryant: Brooklyn Med. Jour., 1906, vol. 20, p. 92	Male	3 yrs.	1 yr.	1 yr. 10 days	Left	1 yr.	Not stated	Not stated		Nephrectomy		Recovery	Died in 10 days	"Round and spindle cell sarcoma"

CASES OF EMBRYONIC TUMORS. (Continued)

No.	Name and Reference	Sex	Age	Duration Before Operation	Duration of Disease up to Time of Death	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result	Histologic Structure
19	Bryant: Brooklyn Med. Jour., 1906, vol. 20, p. 93	Female	1 yr. 4 mos.	2 wks.	2 wks.	Right	2 wks.	Yes	Not stated		Nephrectomy		Died in 12 hrs.		"Round cell sarcoma"
20	Cohnheim: Virch. Arch., 1875, vol. 65, p. 64	Not stated	1 yr. 3 mos.		3 mos.	Right, also left	3 mos. Small tumor also in opposite kidney	Not stated	Not stated	Hectic fever		None		Died 3 mos. after first symptom	Both kidneys had same structures. Striated muscle. Fat. Stroma of round cells
21	Croft: Lancet, 1885, vol. 1, p. 936	Male	3 yrs.	Few wks.	Not stated	Right	Yes	Not stated	Initial symptom		Nephrectomy		Recovery	Not stated	"Round cell sarcoma"
22	Cuno and Trappe: Dtsch. Med. Woch., 1906, vol. 32, p. 105	Male	3 yrs.	6 mos.		Left	6 mos.	Not stated	Not stated		Nephrectomy		Recovery	Well 6 mos. later	Tubular structures. Smooth muscle. "Connective tissue of embryonic type (sarcoma)"
23	Czerny: Dtsch. Med. Woch., 1881, vol. 7, p. 422	Female	3 yr. 6 mos.		Several months	Not stated	2 mos.	Not stated	Initial symptom			Lungs		Died	"Round cell sarcoma"
24	Dandois: Bul. Royal Acad. Med. Belg., 1895, 3rd Series, vol. 19, p. 839	Male	2 yrs. 1 mo.	5 mos.		Right	5 mos.	Not stated	Not stated		Nephrectomy		Recovery	Well 4 mos. later	Tubular structures. Epithelial cell nests. Stroma similar to ordinary sarcoma

CASES OF EMBRYONIC TUMORS. (Continued)

No.	Name and Reference	Sex	Age	Duration Before Operation	Duration of Disease up to Time of Death	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result	Histologic Structure
[illegible]	Duplerlein and Ulrich-Hirschfeld: Centr. f. d. Krankh. der Harn und Sexual Organe, 1894, vol. 5, p. 5	Female	7 yrs.	9 mos.		Not stated	9 mos.	Not stated	Not stated		Nephrectomy		Recovery	Well 3 mos. later	Tubular structures. Stroma of round cells. Smooth and striated muscle. (This case was the first one which was definitely regarded in a correct light. This was the first time that the term "mixed tumor" was used)
26	Dohrn: Centr. f. Gyn., 1893, vol. 14, p. 753	Female	3 yrs.	2 mos.		Right	2 mos.	Not stated	Not stated		Nephrectomy		Recovery	Well 2 mos. later	Stroma of round cells and also spindle cells. Striated muscle
27	Eberth: Virch. Arch., 1879, vol. 55, p. 518	Female	1 yr. 5 mos.	3 mos.	3 mos.	Right	3 mos.	Not stated	Not stated			Peritoneum	Death		Smooth and striated muscle. Stroma in part spindle cells, in part round cells
28	Eve: Tr. Path. Soc., London, 1889, vol. 33, p. 312	Male	1 yr. 4 mos.		Not stated (Few wks.)	Right	1 week	No pain	Not stated	Fluctuation				Death	Striated muscle. Stroma of round and a few spindle cells
29	Fischer: Diss. Inaug. Chir., 1898, vol. 29, p. [illegible]	Male	4 yrs. 6 mos.	3 mos.	7 mos.	Left	3 mos.	No pain	Not stated		Nephrectomy. Operated for metastases later	"Abdominal"	Recovery	Died 4 mos. after nephrectomy and 3 mos. after recurrence	"Spindle and round celled sarcoma." No other structures mentioned

CASES OF EMBRYONIC TUMORS. (Continued)

No.	Name and Reference	Sex	Age	Duration Before Operation	Duration of Disease up to Time of Death	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result	Histologic Structure
30	Flöriken: Beitr. z. Klin. Chir., 1906-07, vol. 52, p. 732	Male	5 yrs.	9 mos.	9 mos.	Left	9 mos.	Not stated	Not stated		Nephrectomy	Frontal and parietal regions of the dura	Death		Tubular structures. Small cysts. Stroma of spindle cells
31	Godlee: Med. Times and Gazette, 1884, vol. 2, p. 627	Male	1 yr. 10 mos.	3 mos.	9 mos.	Right	3 mos.	No pain	Not stated		Nephrectomy	Right iliac fossa and scrotum	Recovery	Died 6 mos. after operation	"Round and spindle celled sarcoma." No mention of other structures
32	Heidemann: Dtsch. Med. Woch., 1893, vol. 19, p. 265	Not stated	1 yr. 6 mos.	Not stated	Not stated	Not stated	Yes	Not stated	Not stated					Death	"Sarcomatous stroma." Abundant striated muscle
33	Heinlein: Münch. Med. Woch., 1895, vol. 42, p. 660	Male	1 yr. 3 mos.			Right	Yes				Nephrectomy		Recovery	Well 9 mos. later	"Small round cell sarcoma." No other structures mentioned
34	Herzog: Am. Jour. Med. Sci., 1900, vol. 119, N. S., p. 698	Female	1 yr. 3 mos.	Not stated	Not stated	Not stated	Yes	Not stated	Not stated	Gastro-intestinal disturbance				Not stated	Epithelial cell nests. Tubular structures. Striated muscle. "Embryonal stroma"
35	Hicquet: Bul. Acad. Royale de Med., Belg., 1882, vol. 16, p. 41	Female	6 yrs.	Not stated		Left	Yes	Yes	Not stated		Nephrectomy		Recovery	Well 4 mos. later	Tubular structures. Sarcoma stroma. "Adenosarcoma"

CASES OF EMBRYONIC TUMORS. (Continued)

No.	Name and Reference	Sex	Age	Duration Before Operation	Duration of Disease up to Time of Death	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result	Histologic Structure
36	Holsholt: Virch. Arch., 1886, vol. 104, p. 118	Male	18 yrs.	Not stated	8 mos.	Left	Yes	Yes	Not stated			Peritoneum, right lung, and vena cava		Death	Smooth and striated muscle. Cartilage. "Sarcoma stroma"
37	Huber: Dtsch. Arch. f. klin. Med., 1878-79, vol. 23, p. 206	Male	3 yrs. 6 mos.	Not stated	6 mos.	Left	6 mos.	No pain	Not stated	Edema of legs		Glands in right axilla, liver		Death	Round cell stroma. Striated muscle. Smooth muscle. Epithelial cell nests. Tubular structures
38	Israel: Chir. klin. d. Nierenkrankheiten, Berlin, 1901, p. 519	Male	5 yrs.	Not stated	Not stated	Right	Yes	Not stated	Not stated		Nephrectomy	Liver	Recovery	Died a short time later from the recurrence	Tubular structures. Round cell stroma
39	Israel: Chir. klin. d. Nierenkrankheiten, Berlin, 1901, p. 520	Female	7 yrs.	6 days	Not stated	Right	Yes	Slight	Yes, 6 days		Nephrectomy	Lungs and liver	Recovery	Died in a short time from recurrence	Tubular structures. Cartilage. Spindle cell stroma
40	Israel: Berl. klin. Woch., 1890, vol. 27, p. 640	Male	1 yr. 2 mos.	2 weeks		Right	Yes	Yes, 2 weeks	None		Nephrectomy		Recovery	Well 2 yrs. later	"Groups of cells lying in connective tissue framework." Was called "alveolar sarcoma"
41	Jacobi: Congrès Périodique Inter. des. Sci. Méd., Copenhagen, 1886, vol. 3, p. 16	Male	2 yrs. 6 mos.	Not stated	Not stated	Left	Yes							Death	"Round and spindle cell sarcoma." No other structures

CASES OF EMBRYONIC TUMORS. (Continued)

No.	Name and Reference	Sex	Age	Duration Before Operation	Duration of Disease up to Time of Death	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result	Histologic Structure
42	Jacobi: Congrès Périodique Inter. des Sci. Méd., Copenhagen, 1886, vol. 3, p. 16	Male	2 yrs.		A short time	Right	Yes	Not stated	Not stated	Fluctuation				Death	"Round cell sarcoma." No other structures mentioned
43	Jacobi: Congrès. Périodique Inter. des Sci. Méd., Copenhagen, 1886, vol. 3, p. 16	Male	2 yrs. 8 mos.		1 yr.	Left	Yes	Not stated	Yes, in the beginning	Initial symptom convulsion and temporary anuria followed by hematuria				Death	Stroma of round and spindle cells. Much striated muscle
44	Jenckel: Dtsch. Zeit. f. Chir., 1901, vol. 60, p. 502	Female	43	8 yrs.		Right	8 yrs.	No pain	None	No symptoms except tumor	Nephrectomy	None	Recovery	Well 2 yrs. later	Tumor weighed 14½ pounds. A few cysts. Smooth muscle. Spindle and round cell stroma. Myxomatous tissue in stroma. Cartilage. Tubular structures. Fat
45	Jones: Arch. Pediat., 1906, vol. 23, p. 281	Male	7 mos.	7 mos.	7 mos.	Both sides	7 mos.	Not stated	Not stated	Separation of recti	Exploratory incision		Death		Tubular structures. Stroma of round and spindle cells. Myxomatous tissue in places. Striated muscle
46	Jordan: British Med. Jour., 1904, vol. 2, p. 1318	Not stated	4 mos.	4 mos.	4 mos.	Not stated	4 mos.	None	None	Diarrhea, vomiting since birth				Death	Cysts. Tubular structures. Epithelial cell nests

CASES OF EMBRYONIC TUMORS. (Continued)

No.	Name and Reference	Sex	Age	Duration Before Operation	Duration of Disease up of Time of Death	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result	Histologic Structure
47	Wilkinson: Kelynack: Renal Growths, London, 1898, p. 102	Not stated	Not stated		3 mos.	Both sides	Yes, 3 mos.							Death	Round and spindle cell stroma. Striated muscle. Tubular structures
48	Kocher and Langhans: Dtsch. Zeit. f. Chir., 1878, vol. 9, p. 321	Female	35	13 mos.	13 mos. 3 days	Right	13 mos.	Yes, 9 mos.	Yes, 9 mos., at intervals		Nephrectomy		Died in 3 days		Striated muscle. Tubular structures. Round cell stroma
49	Kocher and Langhans: Dtsch. Zeit. f. Chir., 1878, vol. 9, p. 312	Male	2 yrs. 6 mos.	2 yrs. 6 mos.	2 yrs. 6 mos. 2 days	Not stated	2 yrs. 6 mos.			Cyanosis	Nephrectomy	None	Died in 2 days		Striated muscle. Tubular structures. Round cell stroma ("embryonic")
50	Koplik (Lewi: Arch. Pediat., 1896, vol. 13, p. 81)	Female	4 yrs. 1 mo.		10 mos.	Left	8 mos.	Not stated	Not stated	Edema of legs				Death	Round and spindle cell stroma. Striated muscle
51	Landsburger and Cohnheim: Berl. klin. Woch., 1877, vol. 14, p. 497	Female	7 mos.		Not stated	Right	6 days			First symptoms dyspnea, cough, and sleeplessness				Death	Striated muscle. Sarcoma stroma
52	Manasse, Virch. Arch., vol. 145, p. 148	Female	3 yrs.	3 weeks	1 yr. 3 wks.	Not stated	3 wks.	Not stated	Not stated		Nephrectomy	Abdomen	Recovery	Died 1 yr. after operation	Striated muscle. Cartilage. Tubular structures. Stroma of small round cells

CASES OF EMBRYONIC TUMORS. (Continued)

No.	Name and Reference	Sex	Age	Duration Before Operation	Duration of Disease up to Time of Death	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result	Histologic Structure
53	Marchand: Virch. Arch., 1878, vol. 73, p. 289	Male	1 yr. 4 mos.		9 mos.	Right	9 mos.	No pain	None					Death	Striated muscle. Round cell stroma. Epithelial cell nests
54	McBurney: Ann. of Surg., 1894, vol. 20, p. 373	Male	10 yrs			Right	Yes	Yes	Not stated		Nephrectomy	Bowel	Recovery	Not stated but recurrence expected, in bowel	Striated muscle. Cartilage. Tubular structures. Sarcoma stroma
55	Morton: British Med. Jour., 1900, vol. 1, p. 249	Male	1 yr. 6 mos.	Not stated	3 mos.	Left	Yes	Not stated	Not stated		Nephrectomy			Death	Stroma of round and spindle cells. Tubular structures
56	Merkel: Zeigler Beitr., 1898, vol. 24, p. 481	Female	2 yrs.	1 week	1 week	Right	1 week		None	Fever	Nephrectomy	Vena cava, lungs	Death		Stroma of "sarcomatous tissue." Tubular structures
57	Merkel, Zeigler Beitr., 1898, vol. 24, p. 481	Male	6 mos.	6 mos.	6 mos. 2 days	Both sides	6 mos.	Not stated	Not stated		Nephrectomy	None	Died in 2 days		Stroma of "sarcomatous tissue." Tubular structures. Striated muscle
58	Muus: Virch. Arch., 1899, vol. 156, p. 403	Male	1 yr. 6 mos.	Not stated		Left	Yes	Not stated	Not stated		Nephrectomy	Local recurrence	Recovery	Died 2 mos. later	Stroma of round and spindle cells. Epithelial cell nests. Tubular structures. Striated muscle. Smooth muscle

CASES OF EMBRYONIC TUMORS. (Continued)

No.	Name and Reference	Sex	Age	Duration Before Operation	Duration of Disease up to Time of Death	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result	Histologic Structure
59	Muus: Virch. Arch., 1899, vol. 155, p. 406. (See also Marchand: Berl. klin. Woch., 1895, vol. 32, p. 924)	Female	34 yrs.		Several months	Left	Several mos.	Not stated	Not stated	Patient had tumor during pregnancy				Death	Stroma of "sarcomatous tissue." Striated muscle. Smooth muscle. Fat. Epithelial cell nests. Tubular structures
60	Muus: Virch. Arch., 1899, vol. 155, p. 408	Male	8 yrs.	Not stated	Not stated	Right	Yes	Not stated	Not stated					Death	Stroma of round and spindle cells. Striated muscle. Epithelial cell nests
61	Muus: Virch. Arch., 1899, vol. 155, p. 408	Female	8 yrs.	Not stated	Not stated	Left	Yes	Not stated	Not stated		Nephrectomy		Immediate death		Tubular structures. Sarcoma stroma
62	Muus: Virch. Arch., 1899, vol. 155, p 408	Male	9 mos.	Not stated		Not stated	Yes	Not stated	Not stated		Nephrectomy		Recovery	Well 2 yrs. 9 mos. after operation	"Tumor is composed of a fibrillated connective tissue in which are epithelial alveoli and some small dilated cysts. There are many giant cells"
63	Muus: Virch. Arch., 1899, vol. 155, p. 401	Male	2 yrs.	Not stated	Not stated	Not stated	Yes	Not stated	Not stated					Death	"Sarcoma structure." Epithelial cell nests. Tubular structures
64	Neumann: Dtsch. Arch. f. klin. Med., 1882, vol. 30, p. 577	Female	5 yrs. 9 mos.		1 yr. 3 mos.	Left	6 mos.	Initial symptom peritonitis	Not stated	Edema of legs and lungs				Death	Cysts. Stroma of spindle cells

CASES OF EMBRYONIC TUMORS. (Continued)

No.	Name and Reference	Sex	Age	Duration Before Operation	Duration of Disease up to Time of Death	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result	Histologic Structure
65	Oshima: Wien. klin. Woch. 1907, vol. 20, p. 95	Female	2 yrs. 3 mos.	3 days	7 days	Right	Yes	Yes	Not stated	Severe vomiting	Nephrectomy	None	Died in 4 days		"Mixed tumor of the kidney."
66	Oshima: Wein. klin. Woch., 1907, vol. 20, p. 96	Female	1 yr. 3 mos.		3 weeks	Left	Yes	Not stated	Not stated			Retroperitoneal glands, mediastinal glands		Death	Stroma of small round cells. No other structures mentioned
67	Osler: Jour. of Anat. and Phys., 1879, vol. 14, p. 229	Male	1 yr. 7 mos.		Not stated	Left	Yes	Not stated	Not stated	Vomiting and gastro-intestinal symptoms				Death	Stroma of round and spindle cells. Striated muscle
68	Osler: Jour. of Anat. and Phys., 1879, vol. 14, p. 230	Female	3 yrs. 3 mos.	Not stated	Not stated	Left	Yes	Not stated	Not stated	Fluctuation. Death from choking				Death	Stroma of small round cells. Spindle cells. Smooth muscle. Striated muscle
69	Perthes: Dtsch. Zeit. f. Chir., 1896, vol. 42 p. 216	Male	2 yrs. 6 mos.	6 mos.	7 mos. 2 wks.	Right	6 mos.	Not stated	Not stated		Nephrectomy		Recovery	Death 6 wks. after operation	Tumor projected into pelvis and first part of ureter. Stroma of sarcomatous tissue. Epithelial cell nests. Striated muscle
70	Perthes: Dtsch. Zeit. f. Chir., 1896, vol. 42, p. 217	Male	5 yrs.	2 weeks	6 mos. 2 wks.	Left	2 wks.	Not stated	Not stated		Nephrectomy		Recovery	Died in 6 mos.	Stroma of sarcomatous tissue. Striated muscle. Smooth muscle. Tubular structures

CASES OF EMBRYONIC TUMORS. (Continued)

No.	Name and Reference	Sex	Age	Duration Before Operation	Duration of Disease up to Time of Death	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result	Histologic Structure
71	Perthes: Dtsch. Zeit. f. Chir., 1896, vol. 42, p. 218	Male	11 yrs.	5 mos.	8 mos.	Right	5 mos.	None	Not stated		Nephrectomy		Recovery	Died 3 mos. after operation	Stroma of round cells. Epithelial cell nests. Hyaline cartilage
72	Perthes: Dtsch. Zeit. f. Chir., 1896, vol. 42, p. 237	Male	2 yrs. 9 mos.	4 weeks	5 wks.	Right	4 wks.	Not stated	Not stated		Nephrectomy		Died 1 week after operation		"Round cell sarcoma"
73	Rachmaninow: Arch. f. Kinderh., Stuttgart, 1906, vol. 44, p. 325	Female	3 yrs. 6 mos.		6 mos.	Left	6 mos.	Not stated	Not stated					Death	Smooth muscle fibres. Stroma of spindle cells
74	Rachmaninow: Arch. f. Kinderh., Stuttgart, 1906, vol. 44, p. 322	Male	5 yrs.	1 mo.	2 mos.	Left	1 mo.	1 mo.	Not stated		Nephrectomy	Retroperitoneal glands	Recovery	Died in 1 mo.	Tubular structures. Smooth muscle. Stroma of round and spindle cells
75	Rachmaninow. Arch. f. Kinderh., Stuttgart, 1906, vol. 44, p. 321	Male	1 yr. 2 mos.		3 mos.	Left	6 wks.	Not stated	Not stated					Death	"Stroma of sarcomatous tissue." Striated muscle
76	Rachmaninow: Arch. f. Kinderh., Stuttgart, 1906, vol. 44, p. 321	Female	2 yrs. 6 mos.			Left	Yes	Not stated	Not stated		Incomplete operation		Died at once		"Tumor was composed of myxomatous and fibrillated (sarcoma?) connective tissue." Epithelial cell nests. Striated muscle

CASES OF EMBRYONIC TUMORS. (Continued)

No.	Name and Reference	Sex	Age	Duration Before Operation	Duration of Disease up to Time of Death	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result	Histologic Structure
77	Ribbert: Virch. Arch., 1886, vol. 106, p. 282. (See also Witzel: Dtsch. Zeit. f. Chir., 1886, vol. 24, p. 338.)	Female	4 yrs.	6 weeks	6 weeks	Right	6 wks.	Not stated	Not stated		Nephrectomy	None	Death at once		Tumor masses in pelvis and kidney. Stroma of small spindle cells. Striated muscle. Epithelial cell nests Fat. Tubular structures
78	Roberts: Amer. Prac. and News, 1888, vol. 6, p. 33	Female	5 yrs. 6 mos.	Not stated		Left	Yes	Not stated	Not stated		Nephrect.		Recovery	Not stated	"Abundant infiltration of embryonic elements; a mass of small spherical embryonic cells"
79	Scheven and Ribbert: Berl. klin. Woch., 1886, vol. 23, p. 450	Female	4 yrs.	Not stated	Not stated	Not stated	Yes	Not stated	Not stated		Nephrect.		Died in 6 days		Tumor masses projecting in ureter. "Spindle cell sarcoma"
80	Schmid: Münch. Med. Woch., 1892, vol. 39, p. 256	Female	6 mos.	Not stated		Left	Yes	Not stated	Not stated		Nephrect.		Recovery	Well 1 yr, 7 mos. later	"Sarcoma involving the entire kidney." No structures mentioned
81	Schmid: Centr. f. Chir., 1893, vol. 20, p. 672	Male	6 mos.	Not stated		Left	Yes	Not stated	Not stated		Nephrect.		Recovery	Well 3 yrs. later	"Sarcoma of left kidney." No structures mentioned
82	Steele: Medicine, 1895, vol. 1, p. 11	Male	1 yr. 4 mos.	Not stated		Left	Yes	Not stated	Not stated		Nephrect.		Recovery	Three mos. later well	Tumor weighed seven pounds. Stroma of small round cells. No other structure mentioned

CASES OF EMBRYONIC TUMORS. (Continued)

No.	Name and Reference	Sex	Age	Duration Before Operation	Duration of Disease up to Time of Death	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result	Histologic Structure
83	Steele: Medicine, 1895, vol. 1, p. 14	Female	3 yrs. 8 mos.	9 days		Right	Yes	Initial symptom			Nephrect.		Recovery	Not stated	"Small spindle cell sarcoma. Seemed to have originated in capsule"
84	Steinhardt: Arch. f. Kinderh., Stuttgart, 1903-04, vol. 38, p. 30	Male	3 yrs. 6 mos.		Not stated	Left	Yes	None	None			Lungs and liver		Death	"Round and spindle cell sarcoma"
85	Stewart: Am. Jour. Med. Sci., 1897, vol. 94, N. S., p. 470	Female	1 yr. 8 mos.	Not stated	Not stated	Right	Yes	Not stated	Not stated		Nephrect.		Died at once		Stroma of spindle cells. No other structures mentioned
86	Strong: Arch. Pediat., 1903, vol. 20, p. 321	Male	3 yrs.			Not stated	Yes	Not stated	Not stated					Death	Tubular structures. Striated muscle. Stroma of spindle cells
87	Strong: Arch. Pediat., 1903, vol. 20, p. 321	Male	4 yrs.	Not stated	Not stated	Both sides, second tumor appearing later	Yes	Not stated	Not stated		Nephrect.	Liver	Recovery	Died soon after operation	Tubular structures. Epithelial cell nests. Stroma of spindle cells. Cartilage
88	Taylor: Am. Jour. Med. Sci., 1897, vol. 94, N. S., p. 461	Male	3 yrs.		Not stated	Left	Yes	Not stated	Not stated	Vomiting		Lungs		Death	"Round cell sarcoma"
89	Thornton: (Day): Trans. Path. Soc., London, 1881, vol. 32, p. 142	Female	4 yrs.		4 mos.	Right	2 mos.	2 mos.	Not stated	Heart displaced upward				Death	"Round and spindle cell sarcoma"

CASES OF EMBRYONIC TUMORS. (Continued)

No.	Name and Reference	Sex	Age	Duration Before Operation	Duration of Disease up to Time of Death	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result	Histologic Structure
90	Wagner: Dtsch. Zeit. f. Chir., 1886, vol. 24, p. 507	Female	5 yrs.	6 weeks	6 weeks	Left	6 wks.	Not stated	Not stated	Fever	Incision. Inoperable	None	Death at once		Stroma of small round cells. Tubular structures
91	Wagner: Dtsch. Zeit. f. Chir., 1886, vol. 24, p. 509	Female	3 yrs.	9 mos.	9 mos.	Right	9 mos.	Not stated	Not stated		Incision. Inoperable	None	Death at once		"Sarcoma." Apparently originating from the kidney capsule
92	Wagner: Dtsch. Zeit. f. Chir., 1886, vol. 24, p. 512	Male	5 yrs.		5 mos.	Right	Yes	Initial symptom	Not stated			Mesentery, intestinal walls, and peritoneum		Death	"Small round cell sarcoma"
93	Wagner: Dtsch. Zeit. f. Chir., 1886, vol. 24, p. 505	Female	4 yrs. 6 mos.	3 mos.	5 mos.	Both sides	Yes	3 mos.	Not stated	Diminished urine	Incision. Inoperable	Lungs and liver	Died immediately		Stroma of large round cells
94	Walker: (Finney): Ann. Surg., 1897, vol. 26, p. 535	Female	13 yrs.	Not stated	Not stated	Right	Yes	Pain on the left	Not stated		Nephrect.		Died at once		"Round and spindle cell sarcoma." No other structures mentioned
95	Walker (Halsted): Ann. Surg., 1897, vol. 26, p. 531	Male	4 yrs.	3 mos.	3 mos.	Left	2 mos.	Not stated	Initial symptom. 3 mos.	Vomiting	Incision. Inoperable	Lungs	Died at once		Stroma of round and spindle cells. Epithelial cell nests

CASES OF EMBRYONIC TUMORS. (Continued)

No.	Name and Reference	Sex	Age	Duration Before Operation	Duration of Disease up to Time of Death	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result	Histologic Structure
96	Webb: Lancet, 1902, vol. 2, p. 1048	Female	6 yrs.	Not stated	Not stated	Right	Yes	Initial Symptom	Not stated		Nephrect.		Died in 2 hrs.		Tubular structures. Stroma of spindle cells. Cartilage
97	Wentworth: Arch. Pediat., 1896, vol. 13, p. 330	Female	3 mos.		Not stated	Left	Yes	Not stated	Not stated					Death	Stroma of spindle cells. No other structure mentioned
98	Werder: Am. Lancet, 1895, vol. 19, N. S., p. 94	Female	2 yrs. 1 mo.	Not stated		Left	Yes	Not stated	Not stated		Nephrect.		Recovery	Well 7 mos. later	Striated muscle. "Sarcomatous stroma"
99	Werner: Ther. Gaz., 1892, vol. 16, p. 734	Female	2 yrs.	Not stated		Left	Yes	Not stated	Not stated		Nephrect.		Recovery	Not stated	Stroma of spindle cells. Striated muscle
100	Williams: Trans. Path. Soc., London, 1882, vol. 33, p. 317	Male	1 yr. 1 mo.		4 mos.	Right	4 mos.	Not stated	Not stated					Death	Striated muscle. Stroma of round and spindle cells

CASES OF EMBRYONIC TUMORS. (Continued)

No.	Name and Reference	Sex	Age	Duration Before Operation	Duration of Disease up to Time of Death	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result	Histologic Structure
65	Oshima: Wien. klin. Woch., 1907, vol. 20, p. 95	Female	2 yrs. 3 mos.	3 days	7 days	Right	Yes	Yes	Not stated	Severe vomiting	Nephrectomy	None	Died in 4 days		"Mixed tumor of the kidney."
66	Oshima: Wein. klin. Woch., 1907, vol. 20, p. 96	Female	1 yr. 3 mos.		3 weeks	Left	Yes	Not stated	Not stated			Retroperitoneal glands, mediastinal glands		Death	Stroma of small round cells. No other structures mentioned
67	Osler: Jour. of Anat. and Phys., 1879, vol. 14, p. 229	Male	1 yr. 7 mos.		Not stated	Left	Yes	Not stated	Not stated	Vomiting and gastro-intestinal symptoms				Death	Stroma of round and spindle cells. Striated muscle
68	Osler: Jour. of Anat. and Phys., 1879, vol. 14, p. 230	Female	3 yrs. 3 mos.	Not stated	Not stated	Left	Yes	Not stated	Not stated	Fluctuation. Death from choking				Death	Stroma of small round cells. Spindle cells. Smooth muscle. Striated muscle
69	Perthes: Dtsch. Zeit. f. Chir., 1896, vol. 42 p. 216	Male	2 yrs. 6 mos.	6 mos.	7 mos. 2 wks.	Right	6 mos.	Not stated	Not stated		Nephrectomy		Recovery	Death 6 wks. after operation	Tumor projected into pelvis and first part of ureter. Stroma of sarcomatous tissue. Epithelial cell nests. Striated muscle
70	Perthes: Dtsch. Zeit. f. Chir., 1896, vol. 42, p. 217	Male	5 yrs.	2 weeks	6 mos. 2 wks.	Left	2 wks.	Not stated	Not stated		Nephrectomy		Recovery	Died in 6 mos.	Stroma of sarcomatous tissue. Striated muscle. Smooth muscle. Tubular structures

CASES OF EMBRYONIC TUMORS. (Continued)

No.	Name and Reference	Sex	Age	Duration Before Operation	Duration of Disease up to Time of Death	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result	Histologic Structure
71	Perthes: Dtsch. Zeit. f. Chir., 1896, vol. 42, p. 218	Male	11 yrs.	5 mos.	8 mos.	Right	5 mos.	None	Not stated		Nephrectomy		Recovery	Died 3 mos. after operation	Stroma of round cells. Epithelial cell nests, Hyaline cartilage
72	Perthes: Dtsch. Zeit. f. Chir., 1896, vol. 42, p. 237	Male	2 yrs. 9 mos.	4 weeks	5 wks.	Right	4 wks.	Not stated	Not stated		Nephrectomy		Died 1 week after operation		"Round cell sarcoma"
73	Rachmaninow: Arch. f. Kinderh., Stuttgart, 1906, vol. 44, p. 325	Female	3 yrs. 6 mos.		6 mos.	Left	6 mos.	Not stated	Not stated					Death	Smooth muscle fibres. Stroma of spindle cells
74	Rachmaninow: Arch. f. Kinderh., Stuttgart, 1906, vol. 44, p. 322	Male	5 yrs.	1 mo.	2 mos.	Left	1 mo.	1 mo.	Not stated		Nephrectomy	Retroperitoneal glands	Recovery	Died in 1 mo.	Tubular structures. Smooth muscle. Stroma of round and spindle cells
75	Rachmaninow. Arch. f. Kinderh., Stuttgart, 1906, vol. 44, p. 321	Male	1 yr. 2 mos.		3 mos.	Left	6 wks.	Not stated	Not stated					Death	"Stroma of sarcomatous tissue." Striated muscle
76	Rachmaninow: Arch. f. Kinderh., Stuttgart, 1906, vol. 44, p. 321	Female	2 yrs. 6 mos.			Left	Yes	Not stated	Not stated		Incomplete operation		Died at once		"Tumor was composed of myxomatous and fibrillated (sarcoma?) connective tissue." Epithelial cell nests. Striated muscle

CASES OF EMBRYONIC TUMORS. (Continued)

No.	Name and Reference	Sex	Age	Duration Before Operation	Duration of Disease up to Time of Death	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result	Histologic Structure
77	Ribbert: Virch. Arch., 1886, vol. 106, p. 282. (See also Witzel: Dtsch. Zeit. f. Chir., 1886, vol. 24, p. 338.)	Female	4 yrs.	6 weeks	6 weeks	Right	6 wks.	Not stated	Not stated		Nephrectomy	None	Death at once		Tumor masses in pelvis and kidney. Stroma of small spindle cells. Striated muscle. Epithelial cell nests Fat. Tubular structures
78	Roberts: Amer. Prac. and News, 1888, vol. 6, p. 33	Female	5 yrs. 6 mos.	Not stated		Left	Yes	Not stated	Not stated		Nephrect.		Recovery	Not stated	"Abundant infiltration of embryonic elements; a mass of small spherical embryonic cells"
79	Scheven and Ribbert: Berl. klin. Woch., 1886, vol. 23, p. 450	Female	4 yrs.	Not stated	Not stated	Not stated	Yes	Not stated	Not stated		Nephrect.		Died in 6 days		Tumor masses projecting in ureter. "Spindle cell sarcoma"
80	Schmid: Münch. Med. Woch., 1892, vol. 39, p. 256	Female	6 mos.	Not stated		Left	Yes	Not stated	Not stated		Nephrect.		Recovery	Well 1 yr. 7 mos. later	"Sarcoma involving the entire kidney." No structures mentioned
81	Schmid: Centr. f. Chir., 1893, vol. 20, p. 672	Male	6 mos.	Not stated		Left	Yes	Not stated	Not stated		Nephrect.		Recovery	Well 3 yrs. later	"Sarcoma of left kidney." No structures mentioned
82	Steele: Medicine, 1895, vol. 1, p. 11	Male	1 yr. 4 mos.	Not stated		Left	Yes	Not stated	Not stated		Nephrect.		Recovery	Three mos. later well	Tumor weighed seven pounds. Stroma of small round cells. No other structure mentioned

CASES OF EMBRYONIC TUMORS. (Continued)

No.	Name and Reference	Sex	Age	Duration Before Operation	Duration of Disease up to Time of Death	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result	Histologic Structure
83	Steele: Medicine, 1895, vol. 1, p. 14	Female	3 yrs. 8 mos.	9 days		Right	Yes	Initial symptom			Nephrect.		Recovery	Not stated	"Small spindle cell sarcoma. Seemed to have originated in capsule"
84	Steinhardt: Arch. f. Kinderh., Stuttgart, 1903-04, vol. 38, p. 30	Male	3 yrs. 6 mos.		Not stated	Left	Yes	None	None			Lungs and liver		Death	"Round and spindle cell sarcoma"
85	Stewart: Am. Jour. Med. Sci., 1887, vol. 94, N. S., p. 470	Female	1 yr. 8 mos.	Not stated	Not stated	Right	Yes	Not stated	Not stated		Nephrect.		Died at once		Stroma of spindle cells. No other structures mentioned
86	Strong: Arch. Pediat., 1903, vol. 20, p. 321	Male	3 yrs.			Not stated	Yes	Not stated	Not stated					Death	Tubular structures. Striated muscle. Stroma of spindle cells
87	Strong: Arch. Pediat., 1903, vol. 20, p. 321	Male	4 yrs.	Not stated	Not stated	Both sides, second tumor appearing later	Yes	Not stated	Not stated		Nephrect.	Liver	Recovery	Died soon after operation	Tubular structures. Epithelial cell nests. Stroma of spindle cells. Cartilage
88	Taylor: Am. Jour. Med. Sci., 1887, vol. 94, N. S., p. 461	Male	3 yrs.		Not stated	Left	Yes	Not stated	Not stated	Vomiting		Lungs		Death	"Round cell sarcoma"
89	Thornton: (Day): Trans. Path. Soc., London, 1881, vol. 32, p. 142	Female	4 yrs.		4 mos.	Right	2 mos.	2 mos.	Not stated	Heart displaced upward				Death	"Round and spindle cell sarcoma"

CASES OF EMBRYONIC TUMORS. (Continued)

No.	Name and Reference	Sex	Age	Duration Before Operation	Duration of Disease up to Time of Death	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result	Histologic Structure
90	Wagner: Dtsch. Zeit. f. Chir., 1886, vol. 24, p. 507	Female	5 yrs.	6 weeks	6 weeks	Left	6 wks.	Not stated	Not stated	Fever	Incision. Inoperable	None	Death at once		Stroma of small round cells. Tubular structures
91	Wagner: Dtsch. Zeit. f. Chir., 1886, vol. 24, p. 509	Female	3 yrs.	9 mos.	9 mos.	Right	9 mos.	Not stated	Not stated		Incision. Inoperable	None	Death at once		"Sarcoma." Apparently originating from the kidney capsule
92	Wagner: Dtsch. Zeit. f. Chir., 1886, vol. 24, p. 512	Male	5 yrs.		5 mos.	Right	Yes	Initial symptom	Not stated			Mesentery, intestinal walls, and peritoneum		Death	"Small round cell sarcoma"
93	Wagner: Dtsch. Zeit. f. Chir., 1886, vol. 24, p. 505	Female	4 yrs. 6 mos.	3 mos.	5 mos.	Both sides	Yes	3 mos.	Not stated	Diminished urine	Incision. Inoperable	Lungs and liver	Died immediately		Stroma of large round cells
94	Walker: (Finney): Ann. Surg., 1897, vol. 26, p. 535	Female	13 yrs.	Not stated	Not stated	Right	Yes	Pain on the left	Not stated		Nephrect.		Died at once		"Round and spindle cell sarcoma." No other structures mentioned
95	Walker (Halsted): Ann. Surg., 1897, vol. 26, p. 531	Male	4 yrs.	3 mos.	3 mos.	Left	2 mos.	Not stated	Initial symptom. 3 mos.	Vomiting	Incision. Inoperable	Lungs	Died at once		Stroma of round and spindle cells. Epithelial cell nests

CASES OF EMBRYONIC TUMORS. (Continued)

No.	Name and Reference	Sex	Age	Duration Before Operation	Duration of Disease up to Time of Death	Side	Tumor	Pain	Hematuria	Special Symptoms	Operation	Metastases	Immediate Result	End Result	Histologic Structure
96	Webb: Lancet, 1902, vol. 2, p. 1048	Female	6 yrs.	Not stated	Not stated	Right	Yes	Initial Symptom	Not stated		Nephrect.		Died in 2 hrs.		Tubular structures. Stroma of spindle cells. Cartilage
97	Wentworth: Arch. Pediat., 1896, vol. 13, p. 330	Female	3 mos.		Not stated	Left	Yes	Not stated	Not stated					Death	Stroma of spindle cells. No other structure mentioned
98	Werder: Am. Lancet, 1895, vol. 19, N. S., p. 94	Female	2 yrs. 1 mo.	Not stated		Left	Yes	Not stated	Not stated		Nephrect.		Recovery	Well 7 mos. later	Striated muscle. "Sarcomatous stroma"
99	Werner: Ther. Gaz., 1892, vol. 16, p. 734	Female	2 yrs.	Not stated		Left	Yes	Not stated	Not stated		Nephrect.		Recovery	Not stated	Stroma of spindle cells. Striated muscle
100	Williams: Trans. Path. Soc., London, 1882, vol. 33, p. 317	Male	1 yr. 1 mo.		4 mos.	Right	4 mos.	Not stated	Not stated					Death	Striated muscle. Stroma of round and spindle cells

CHAPTER III.

TUMORS OF THE RENAL PELVIS AND URETER

ETIOLOGY

Israel[1] had two cases of renal pelvic tumor to sixty-eight of the renal parenchyma.

The growths are seen principally between the ages of thirty-five and sixty years, and males are affected a little more frequently than females. The right side is a little oftener attacked than the left. Calculus has been mentioned as an exciting cause of the growth; Albarran and Imbert[2] found eight in their fifty-three cases, or fifteen per cent., in which calculus was found associated with the tumor. In a list of fourteen cases strictly localized ureteral primary growths analyzed by the writer, there were two cases in which calculus was found; Davy's[3] and Metcalf and Safford's[4].

PATHOLOGY

The following growths are found in the renal pelvis and ureter:

1. Epithelial growths.
   - (a) Papilloma.
   - (b) Papillary epithelioma.
   - (c) Epithelioma (non-papillary).
2. Mesodermal growths.

There are also a few growths not included in the above table. Grohé[5] has described an adenocarcinoma of the ure-

[1]Chir. Klin. der Nierenkrankheiten, Berlin, 1901, p. 530.
[2]Loc. cit., p. 470.
[3]Brit. Med. Jour., 1884, p. 757.
[4]Am. Jour. Med. Sci., 1905, n. s., vol. 129, p. 52.
[5]Dtsch. Zeit. f. Chir., 1901, Vol. 60, p. 44.

ter in which the tumor was thought to have originated from the small glands around the upper end of the ureter. Metcalf and Safford[1] also described an adenocarcinoma in a male forty-seven years old. There was a calculus in the lower part of the ureter in this case, and this seemed to have been the exciting cause of the malignant growth. The tumor showed both carcinomatous and adenomatous structure. Hektoen and Reismann[2] have described a tumor of the ureter resembling adenoma. The ureter having no glands, this tumor was explained as springing from "rests" of the Wolffian duct.

The ordinary forms of tumor of the ureter and renal pelvis are exceedingly rare, and but few instances have been recorded in the literature on the subject. Albarran and Imbert[3] record sixty-five cases of this disease.

Epithelial Growths

Papilloma

Papilloma in the pure form is the commonest of the growths affecting this portion of the urinary tract. In Albarran and Imbert's[4] series of fifty-four cases of primary tumor, in twenty-two there were pure papillomatous growths. This tumor may originate in either the ureter or in the pelvis of the kidney, but it more frequently arises in the pelvis. A tumor starting in the pelvis may spread to the ureter by metastasis, or *vice versa*. A growth affecting the pelvis may even give rise to metastasis in the lower end of the ureter. When the tumor arises in the ureter it may attack any part of it, although it has a preference for either extremity. Furthermore, the growth may recur in the ureter after removal of the kidney affected by the primary tumor. Fenwick[5] relates the case of a man seventy

[1] Am. Jour. Med. Sci., 1905, n. s., vol. 129, p. 50.
[2] American Text-book of Pathology, 1901, p. 994.
[3] Les Tumeurs du Rein, Paris, 1903, p. 449.
[4] Loc. cit., p. 450.
[5] Ureteric Meatoscopy in Obscure Diseases of the Kidney, London, 1903, p. 84.

years old, who had his kidney removed for papillomatous disease; in this case the disease returned in the ureter a year later, and gave rise to hematuria. Albarran and Imbert[1] in eight cases in which the ureter was left after nephrectomy noted that in three the disease recurred in the ureter.

The structure of the growth is that usual in papilloma of the mucous membrane. The chief characteristics are

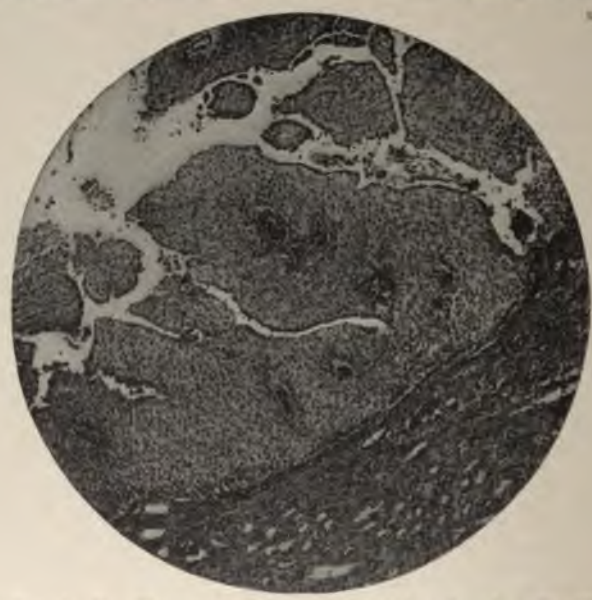

Fig. 30.—Simple Papilloma of the Renal Pelvis, showing Papillae, in the center of each of which the blood vessel runs. The cells are arranged around the blood vessel. From the Lab'y at the Boston City Hospital. No. S02.754.

tufts which are made up of large numbers of small villi closely packed together (Fig. 30). Each villus is composed of a small central vessel around which the epithelial cells are placed in rows several deep; occasionally these cells appear to be placed directly on the capillary walls, but there is usually a connective tissue framework which holds the cells together. The growth is in direct contact with the mucous membrane of the pelvis or the ureter. Occasionally

[1]Loc. cit., p. 484.

the growth does not take the form of isolated tufts, and it occurs as groups of small villosities, giving the mucous membrane a velvety appearance[1]. In this case both kidney pelves were thus covered.

This form of tumor is called benign, but it has a decided tendency to become malignant in the course of time, and the majority of observers are agreed that it should be reckoned a malignant growth. When it becomes malignant the tumor begins to grow in a downward direction, invades the tissue beneath, and gives rise to metastases.

Papillary Epithelioma

This form of tumor is really only a later stage of the tumor just described. It has the usual papillary characteristics, and presents itself on the surface of the mucous membrane in vascular tufts which bleed easily. In the deep layers of the tumor, however, a distinctly epitheliomatous structure with cylindrical cells is seen, and there is a more or less alveolar aspect. Sections of the growth show prolongations into the underlying tissue. In certain parts of the tumor there is a distinct papillary, apparently benign, structure, exactly identical with the tumor previously described. The growth, however, has all the characteristics of cancer, and spreads by continuity and metastasis. Sooner or later, the renal parenchyma is involved by the disease, and when this occurs metastases to other parts of the body have probably already taken place; the growth is particularly apt to extend from its original seat to other parts of the urinary tract. It is not clearly understood why an apparently benign form of papillary growth may exist for a long time, and then pass over into a malignant form. This is distinctive of papillary disease. The malignant character of the papillary form is shown by the fact that it has a high grade of vitality under abnormal conditions, a peculiarity which is usually observed only in malignant neo-

[1]See Murchison's case, Tr. Path. Soc. Lond., 1870, vol. 21, p. 243.

plasms. A simple papillary growth may be present in the ureter, while at the same time there may be a distinctly malignant epithelioma in the pelvis of the kidney. Furthermore, a growth which is apparently benign on its removal, may recur as a malignant growth many years afterward, as in Tikhoff's[1] case; in this case a nephrectomy was performed on a man forty years old, for apparently benign villous papilloma of the pelvis; for ten years the man lived in a state of perfect health, and then there was recurrence in the scar at the site of the previous operation; when this growth was removed it was found to be a medullary carcinoma. In microscopic examination of a growth which has been removed one must be very careful to examine many parts of the tumor, for as Pels-Leusden[2] has shown, a tumor may be apparently benign, and yet a most thorough search will frequently discover a small patch which shows decidedly malignant characteristics.

Non-Papillary Epithelioma

Occasionally, though very rarely, epithelioma of the squamous cell variety is seen. Kundrat[3] was the first to call attention to "epidermoid cancer" arising in the renal pelvis. The growth may arise in the pelvis or in the ureter, although it has a preference for the pelvis. The tumor has the appearance of nodes infiltrating the walls of the ureter or pelvis, which bulge more or less into the cavity of the pelvis, or the lumen of the ureter. These nodes may be single or multiple, and they are red or grayish in color. When the ureter is involved it presents in the form of a large, indurated cord. In structure these tumors are of the type of alveolar carcinoma. Rundle and Targett[4] have described a very characteristic case of this kind, affecting the lower part of the ureter (Fig. 31.) This form of tumor is exceedingly rare, and its finer histologic structure is as

[1]Arch. Prov. de Chir., Paris, 1901, vol. 10, p. 143.
[2]Arch. f. Klin. Chir., 1902, vol. 68, p. 698.
[3]Wien. Klin. Woch., 1891, vol. 4, p. 949.
[4]Tr. Path. Soc., Lond., 1896, vol. 47, p. 128.

yet little understood. These tumors act exactly as other malignant tumors do.

Hallé[1] is of the opinion that these cancers may sometimes become engrafted upon plaques of leukoplasia, which are occasionally found in the mucous membrane of the urinary tract; he is of the opinion that calculus, or other

Fig. 31.—Squamous Cell Cancer of the lower end of the Ureter. From Rundle and Targett; Trans. Path. Soc., London, 1896, Vol. 47, p. 128.

form of inflammation may be the starting point of this leukoplasia. This inflammation, Hallé believes, may lead to epithelial transformation of the mucosa. The normal coating is then transformed into pavement epithelium, which is stratified. In some cases Hallé believes this leukoplasia may be the starting point of a new growth, namely, a lobu-

[1]Ann. des Mal. des Org. Gn. Urin., Paris, 1896, vol. 14, p. 617.

lated pavement epithelioma with epidermoid characters, the "cancroid." Albarran[1] is likewise of the same mind on this subject. He believes that leukoplasia may exist in the renal pelvis or the ureter, and is of the opinion that cancroids of a pavement character are found in these canals. Noting that vesical leukoplasia, like that of other mucous membranes, may transform itself in time into true horny cancroids, Albarran believes that we are justified in concluding that a certain number of pavement cancers of the pelvis may take their origin from these plaques of leukoplasia.

All forms of malignant disease behave in exactly the same way. Extension to surrounding tissues is the rule, and neighboring organs are eventually involved and destroyed. Minich[2] relates the case of a woman sixty-six years old, who had a carcinoma of the lower end of the right ureter; it involved the bladder and fornices of the vagina, and had broken through the vagina, forming an opening which would admit the little finger.

If the ureter is occluded, as it eventually must be in cases of ureteral involvement, secondary hydronephrosis or hematonephrosis is sure to follow. The presence of blood in the urine in these kidney sacs is the usual rule, on account of the ready tendency of the growth to bleed on slight provocation. The ureter above the growth likewise becomes dilated, and may sometimes be felt as a thick cord through the abdominal wall. A small growth situated near the beginning of the ureter in the pelvis of the kidney, although of small size, may, on account of its situation, cause obstruction to the flow of urine, and may give rise to a very large tumor quite out of proportion to the size of the growth itself.

The following strictly localized ureteral growths of a malignant nature have been found in the literature on the

[1] Ann. des Mal. des Org. Gén-Urin., Paris, 1900, vol. 18, p. 713.
[2] Pester Med. Chir. Presse, 1902, p. 941.

subject: Albarran and Imbert[1], in a list of fifty-four cases of primary epithelial tumors of the pelvis and ureter, found sixteen which were papillary epitheliomata of the malignant type. Eight of these were primary in the pelvis, four in the pelvis and ureter, and three affected the ureter alone. These three cases were as follows:

1. Toupet and Gueniot's[2] case, in a female eighty-nine years of age. There was a papillary epithelioma at the entrance of the pelvic end of the ureter, and a little lower there was another growth, but the two tumors were separated by an interval of healthy tissue.

2. Jona's[3] case in an adult male, age unknown. The growth was on the left side. There was a papillary epithelioma in a diverticulum of the lower end of the ureter.

3. Voelker's[4] case of papillary epithelioma in a male sixty-eight years of age. The tumor occupied the last 5 cm. of the ureter, near the bladder.

The following cases have been collected by the writer from other sources:

4. Willutski's[5] case of an alveolar sarcoma of the left ureter in a male twenty-five years of age. The tumor involved the whole left ureter, which it had surrounded to such an extent that it was hard to find the canal.

5. Targett's[6] case of round cell sarcoma of the right ureter, in a male forty-six years of age. The whole ureter was affected.

6. Rundell's[7] case of a squamous cell epithelioma in a male forty-six years of age. The growth involved the lower three inches of the right ureter, and encroached on the seminal vesicle. The tumor was of large size.

7. Vorpahl's[8] case of medullary carcinoma in a female

[1]Loc. cit., p. 455.
[2]Bul. de la Soc. Anat., Paris, 1898, p. 678.
[3]Centr. f. Allg. Path. u. Path. Anat., 1894, vol. 5, p. 659.
[4]Tr. Path. Soc., Lond., 1895. vol. 46, p. 133.
[5]I. D., Königsberg, 1891, p. 21.
[6]Tr. Path. Soc., Lond., 1892, vol. 43, p. 92.
[7]Tr. Path. Soc., Lond., 1896, vol. 47, p. 128.
[8]Am. Jour. Urol., 1906, vol. 2, p. 509.

sixty-three years of age. The lower end of the right ureter was involved.

8. Hektoen's[2] case of a medullary carcinoma in a female fifty years of age. The whole of the right ureter was affected. The tumor was of large size.

9. Wirsung and Blix's[2] case in a female forty-one years of age. There was a medullary carcinoma of the first 15 cm. of the ureter near the bladder.

10. Davy's[3] case in a male fifty-three years of age. The left ureter was affected by a medullary carcinoma. The exciting cause was suspected to have been a calculus which was found with the growth.

11. Metcalfe and Safford's[4] case in a male twenty-five years of age. There was an adenocarcinoma of the left ureter, and here also, a calculus was supposed to have been the exciting cause of the growth.

12. Adler's[5] case in a male sixty-nine years of age. There was a squamous cell carcinoma affecting the lower end of the left ureter.

13. Minich's[6] case in a female sixty-six years of age. There was carcinoma of the lower end of the right ureter.

Mesodermal Growths

Growths of the connective tissue type affecting the pelvis and ureter are of exceedingly rare occurrence, and only a few have been reported. These are as follows:

1. Willutski's case of alveolar sarcoma, already referred to (see Case 4 in previous table).

2. Targett's case of round cell sarcoma of the right ureter (see Case 5 in previous table).

[1]Jour. Am. Med. Ass., 1896, vol. 26, p. 1116.
[2]Archiv. f. Klin. Chir., 1894, p. 357.
[3]Brit. Med. Jour., 1884, p. 757.
[4]Am. Jour. Med. Sci., 1905, n. s., vol. 129, p. 50.
[5]Monatsberichte f. Urol., 1905, vol. 10, p. 129.
[6]Pester Med.-Chir. Presse, 1902, p. 941.

SYMPTOMS

The chief symptoms are, as in the case of renal growth, pain, hemorrhage, and tumor. The pain has nothing specially characteristic, except that it is apt to come on in attacks of colic at unexpected times. This happens when the ureter becomes occluded by a clot. Pain as the first symptom occurs in about one-third of the cases, while in the majority of the cases it is noted as the principal symptom sometime during the course of the disease. The hematuria is painless in character, unless there is a clot formation, and then there may be intense pain. In these cases there is usually vesical disturbance, evidenced by frequent micturition. The ureteral clots passed under these circumstances are very characteristic. They have the appearance of angle worms, and are sometimes of great length. Morris[1] records the case of a man with the disease, who passed an unbroken clot 39 inches in length. The bleeding may be intermittent or continuous, and may extend over a period of many months, and sometimes years. Heaton and Gamgee[2] record the case of a man forty-eight years old, who had his first attack of hematuria nine and a half years before the operation. In this case the hematuria occurred at intervals of about six months. A marked feature of the hematuria is that when it subsides there may be a noticeable increase in the size of the renal tumor. This, of course, is caused by the blocking of the ureter by the clot, with obstruction to the flow of urine, and a subsequent condition of hematonephrosis. This symptom is of extreme diagnostic importance. Occasionally hematuria may be absent during the whole course of the disease. The renal tumor is due both to the collection of fluid distending the renal pelvis, and also to the presence of the growth itself. There is nothing special about the tumor, as it resembles in every respect a tumor of the renal parenchyma. A small growth

[1] Surgical Diseases of Kidney and Ureter, London, 1901, vol. 2, p. 9.
[2] Lond. Lancet, 1902, vol. 2, p. 746.

situated at the site of the ureteral orifice in the pelvis of the kidney, may, by occluding it, give rise to an exceedingly large tumor which is due entirely to distension of the pelvis with accumulated urine.

Changes in the urine are not important, except for the presence of blood. Fragments of villi and numerous epithelial cells are of great diagnostic importance, but it is seldom that villi are to be found. The quantity of urine may be increased or diminished, or it may remain normal. Albuminuria is dependent upon the co-existence of inflammation of the kidney, and the amount of blood in the urine. Inflammatory conditions of the pelvis occasion pyuria.

The general symptoms of the disease will depend upon its stage. In the early part of the trouble the general health is very slightly affected, and the patient may go on for quite a long time without suffering any deterioration in his health. Once, however, the tumor has begun to grow, and especially when it has invaded the neighboring organs and has given rise to metastasis, general symptoms of weakness, loss of appetite, pallor, loss of flesh, nausea, and vomiting may be noted. The termination by exhaustion, or from uremia is common. Occasionally the disease ends in consequence of symptoms due to extension of the growth to some neighboring organ. Thus, it may travel to the lung and cause hemothorax and end life in this way. Among the rarer complications may be mentioned periphlebitis, as in Pantaloni's[1] case. In this case there was undoubtedly an infection of the wall of the pelvis.

A great deal of information may be obtained by cystoscopic examination. The bladder is frequently the seat of a villous tumor, and these tumors may be either secondary or primary. If a villous tumor is found in the bladder, in a case in which there are symptoms pointing to the kidney and ureter, it is evidence that the disease in the upper passage is of the same nature as that in the bladder. Occa-

[1] Arch. Prov. de Chir., 1899, vol. 8, p 2.

sionally a small growth will be seen extruding from the ureter. While this is not in itself evidence that there is no trouble higher up, yet it is very suggestive. A villous tumor in the bladder, which involves the ureteral orifice, and gives rise to symptoms of renal retention, is very puzzling with reference to the existence of growth higher up, and a diagnosis of growth in the upper passage cannot positively be made in such a case. The location of a tumor in the ureter is extremely difficult to determine.

Fenwick[1] has called attention to a very important sign in cases of renal pelvic growth. He has noticed around the ureteral orifice on the affected side, in cases of growth in the pelvis of the kidney in which there is pelvic dilatation, a dull colored swelling and an elongation of the opening of the ureter, the orifice resembling a swollen meatus of the male urethra. In other cases he has noticed the orifice to be of normal size, but the edges roughened, and the interior colored a dull red. The latter condition is especially seen just after a recent profuse renal hemorrhage. Fenwick states, however, that this roughened appearance is not a constant feature, and that the orifice may be of perfectly normal appearance, even after a severe hemorrhage. He concludes, therefore, that this appearance is probably caused by mechanical injury due to the passage of clots.

DIAGNOSIS

The diagnosis of tumor affecting the ureter or the renal pelvis is usually not to be made before operation. In fact, there are but five instances known in literature in which the correct diagnosis was made before operation. The clue to the correct diagnosis is sometimes furnished by renal tumor, hematuria, and by isolating with the renal catheter, urine from the pelvis of the kidney, in which urine there are numerous cells typical of new growth. Albarran was able

[1] Ureteric Meatoscopy in Obscure Diseases of the Kidney and Ureter, London, 1903, p. 79.

to make a diagnosis in this way in three cases by noting this combination of signs, and in his cases ureteral catheterization was of the greatest assistance. The atypical cells were in great numbers, and were quite characteristic. These cells are usually cylindrical or pavement, according to the character of the growth, but their presence is significant only in the absence of chronic pyelitis, for with the latter affection cells of the same character may be found; the distinguishing feature in malignant growth is the absence of pyuria.

The changeable character of the tumor with reference to its size has already been mentioned, and also the intermittent character of the hematuria, and its association with renal colic. The change in the volume of the tumor is very characteristic, and this in particular is a distinguishing feature from tumor of the renal parenchyma, as in the latter cases the tumor seldom changes its volume, and has the characteristics of a solid mass rather than a sac of liquid. The cystoscope gives some information. The presence of tumor at the ureteral orifice is very suggestive of growth higher up. Fenwick's sign may prove to be of great importance. The X-ray may be of assistance. The relation of the kidney to the hydronephrotic sac may be ascertained by injecting into the renal pelvis a 2 per cent. solution of collargolum, which will give a shadow on the photographic plate. If a picture is taken both before and after such injection it may be possible to ascertain the relation of the kidney to the sac itself.

An intermittent hydronephrosis, especially if there is hemorrhage, should always make one suspect tumor of the renal pelvis. Other causes of hydronephrosis should be remembered, such as stricture of the ureter, or the presence of stone, and finally, it should be borne in mind that simple hydronephrosis may be accompanied by hematuria. Calculus rarely gives rise to secondary hydronephrosis, and the hemorrhage with calculus is seldom as abundant as it is

in the case of new growth. The colicky character of the pains in hematuria with clot formation, is suggestive of calculus, and in these cases the differential diagnosis may be extremely difficult.

Fenwick[1] has described two notable cases of hematuria. Both of them were in women. A remarkable feature of the cases was uncontrollable bleeding. At an exploratory nephrotomy the bleeding was found to proceed from a renal papilla and the mucous membrane covering it. In both cases this condition was found, and Fenwick explains it on the supposition that it was due to a localized form of interstitial nephritis.

There are no characteristic symptoms or signs which point to a tumor of the ureter alone. The pains are the same, and there is sure to be a tumor under the ribs in consequence of the obstruction to the flow of urine. The discovery of a growth extruding from the ureteral orifice proves nothing with reference to the presence or absence of disease above. The location of pain in the lower part of the abdomen is somewhat suggestive, and Hektoen's[2] case bears this out. In this case the pain was felt in the right hip, and in the lower part of the bowel. There was medullary carcinoma affecting the ureter in a female fifty years of age, and the pain occasioned by the growth which involved the iliac bone was felt in the right hip during eight months before death.

Enlargement of the Fallopian tube, especially if the tube is near the bladder, may be mistaken for tumor of the lower end of the ureter. Albarran[3] calls attention to this point and relates a case in which salpingitis was mistaken for tumor of the ureter. This diagnosis seemed not improbable in view of the fact that there was a small growth presenting at the orifice of the ureter in the bladder, and on examination it was thought that the mass in the pelvis was

[1]Brit. Med. Jour., Lond., 1900, vol. 1, p. 248.
[2]Jour. Am. Med. Ass., 1896, vol. 26, p. 1116.
[3]Bul. et Mém. Soc. de Chir., Paris, 1902, vol. 28, p. 842.

part of that in the ureter. It was only at the operation that the mistake was discovered.

PROGNOSIS

The prognosis of simple papilloma is serious. The disease may exist in the kidney for a considerable length of time, even months or years, in an apparently benign form; during this time the general health does not suffer at all, or, at the most, not very appreciably. In Pantaloni's[1] case the first symptoms were supposed to have occurred twenty years before the nephrectomy was performed, during which long period of time the patient complained of pains in the renal region. Other instances are not infrequent in which the patient has been suffering from hematuria for quite a long time without further symptoms. Thus, in Heaton and Gamgee's[2] case, the patient, a male forty-eight years old, had been troubled with hematuria for nine and a half years previous to the operation, the bleeding occurring at intervals of about six months. The general course of the disease, therefore, is not serious at first. As it progresses malignant change is apt to take place, and the clinical aspect changes to that of the usual forms of malignant disease of the kidney.

TREATMENT

It has been generally agreed that the only proper treatment is total nephrectomy combined with ureterectomy. This applies not only to those tumors which are evidently malignant, but also to the apparently simple papillomatous tumors. It is necessary to remove the ureter on account of the well-known disposition of the disease to return in the ureter after the kidney has been removed, the recurrence not taking place possibly until many years after.

The treatment of a growth affecting the lower part of

[1]Arch. Prov. de Chir., 1899, vol. 8, p. 2.
[2]Lancet, 1902, vol. 2, p. 746.

the ureter will depend upon the extent of the disease. If the kidney is enlarged from renal retention, nephrectomy as well as ureterectomy is required. In cases in which the lower end of the ureter is diseased, without enlargement of the kidney above, the line of procedure will depend upon the extent of the lesion. If a small growth presents in the bladder it may be excised through a cystotomy wound, or in the female, through a Kelly cystoscope. If, on examination with the catheter, the rest of the ureter is found to be free from the disease, nothing further need be done.. If the tumor is not extensive and preserves its rounded form, it may be possible through a cystotomy wound to remove the tumor, taking with it an elliptical portion of the bladder around the ureteral orifice, and the operation may be completed by implanting the ureter in the vesical wound. This operation was mentioned as having been done by Albarran and Imbert[1]. The disease was carcinoma of the lower end of the ureter, and the man lived in a state of perfect health for six years afterward, and died from suicide.

Should the disease be more extensive, and be accompanied by periureteral enlargement, the ureter may be attacked by an extraperitoneal incision. The sacral route is now never used for operations on the ureter. The site of the operation is more accessible with a transperitoneal operation and this may be selected in aseptic cases. The incision follows the linea semilunaris. After entering the abdomen the peritoneum on the outer side of the colon is opened and the ureter is exposed. In the female the ureter can be dissected up from its position under the uterine artery and followed on to its insertion in the bladder. A portion of the bladder may even be removed with it. In the male the operation is, of course, easier. If a portion of the bladder has been excised with the lower end of the ureter, the upper end of the ureter may be implanted into the bladder or possibly into the ureter of the opposite side. If a

[1]Les Tumeurs du Rein, Paris, 1903, p. 487.

considerable portion of the ureter has been removed so that the remaining part is short, the bladder may be loosened from its position by dissecting it carefully away, and in this way it may be brought to the severed end. Lately, Payne[1] has ingeniously, and for the first time, gained additional approximation by lowering the kidney by the same means. The peritoneum over the ureteral tract is now sewed together, if possible, and the drainage should be through the loin.

Should it be desired to remove kidney and ureter together, the best incision for this purpose is Israel's and the operation should be carried out extraperitoneally. Starting at the anterior edge of the sacrolumbar mass of muscles, a finger's breadth below the twelfth rib, the incision is brought forward parallel to the rib as far as the anterior axillary line; it then turns downward to a point two fingers' breadths from the anterior superior spine of the ilium, and from this point bends downward toward the median line so as to run parallel to Poupart's ligament as far as the outer border of the rectus muscle, in extreme cases beyond this point. The tissues are divided down to the peritoneum. With finger dissection, the peritoneum is carefully pushed back toward the middle of the body, carrying with it the ascending or descending colon and adjoining intestines. It is well to remember that the ureter strips with the peritoneum. Cabot[2] has shown that there are a number of fibrous bands which connect the ureter and peritoneum. Cabot has also shown that the part of the peritoneum which becomes adherent to the spine, is, within a slight range of variation, pretty constant and that the ureter lies just outside the line of adhesion; when the point has been reached at which the peritoneum strips with some difficulty the ureter will usually be found a short distance outside of this location.

It may not be necessary to make the whole incision de-

[1]Jour. Am. Med. Ass., 1908, vol. 51, page 1322.
[2]Am. Jour. of Med. Sci., 1892, vol. 103, page 44.

scribed and in some cases, at least, it will be possible to dissect away the ureter underneath the abdominal wall under the peritoneum; when the uterer can no longer be stripped the incision may be resumed in the line indicated.

Occasionally it may be desirable to remove only the ureteral tumor at the first sitting. If this is so, the cut end of the ureter is brought out into the loin and allowed to drain. The kidney may be removed later.

The immediate results of operation for simple papilloma are good. The patient, as a rule, recovers from the operation, and the mortality is not greater than that for simple nephrectomy for other diseases. There is always grave danger, however, of recurrence of the disease, either immediately, or within a few months or several years after the operation. The peculiarity with reference to the recurrence of the malignant trouble is that it may be in the form of a medullary cancer. Thus, in Tikhoff's[1] case, a simple papilloma of the pelvis, for which nephrectomy was done, was followed by recurrence as medullary carcinoma in the scar ten years later, the patient meanwhile having been in perfectly good health.

Reports of end results following nephrectomy for simple papilloma are very few, and the following five cases are the only ones that could be found in an extensive review of the literature.

No. 1. Fenwick's[2] case in a male seventy years old, who had the right kidney removed for simple papillomatous disease. There was recurrence in a year in the right ureter, and this was removed. The patient died uremic four years later; towards the end there was carcinoma of the prostate, and squamous cell cancer affecting the nephrectomy scar.

No. 2. Fenwick's[3] case in an adult male who had the

[1]Arch. Prov. de Chir., 1901, vol. 10, p. 143.
[2]Ureteric Meatoscopy in Obscure Diseases of the Kidney, London, 1903, p. 80.
[3]Loc. cit., p. 85.

disease in the right kidney, for which nephrectomy was done. The patient was well five years later.

No. 3. Heaton and Gamgee's[1] case. The patient was a male forty-eight years old, who had been suffering for nine years. The kidney was removed and there had been no recurrence up to the time of the report nine months after the operation.

No. 4. Le Dentu and Albarran's[2] case of a male thirty-three years old, the symptoms covering a period of four years. Nephro-ureterectomy was performed and there had been no recurrence fourteen months after the operation.

No. 5. Tikhoff's[3] case, of a male forty years old, who was operated upon by Roux. In this case the symptoms were supposed to have extended over a period of twenty years. Nephrectomy was done and this was followed by a period of ten years during which there were no symptoms. At the end of this time there was recurrence of the disease in the nephrectomy scar as medullary carcinoma, and death followed in six months.

These cases are too few in number to enable us to draw any positive conclusions. They illustrate, however, how serious the disease is, and how grave the danger from recurrence.

The end results are given in nine cases in which nephrectomy was performed for papillary epithelioma.

No. 1. Fenwick's[4] case of a male, fifty-nine years old. The kidney was removed and the disease recurred as carcinoma of the liver six years later, and caused death.

No. 2. Fenwick's[5] case of a male forty years old. The kidney was removed for this disease, and the patient died six months later from recurrence in the loin, groin, and supraclavicular glands.

[1] Lancet, 1902, vol. 2, p. 746.
[2] Bul. de l'Acad. de Méd., 1899, 3 S., vol. 41, p. 240.
[3] Arch. Prov. de Chir., 1901, vol. 10, p. 144.
[4] Ureteric Meatoscopy in Obscure Diseases of the Kidney, London, 1903, p. 89.
[5] Loc. cit., p. 86.

No. 3. Israel's[1] case in a male fifty-two years old. Nephrectomy was performed, and there was recurrence in a year's time.

No. 4. Albarran and Imbert's[2] case in a male forty-five years old. A transperitoneal nephrectomy was performed, and there was recurrence six months later.

No. 5. Grohé's[3] case in a female thirty-seven years old. Nephrectomy was performed and the patient died eight months later.

No. 6. Reynès'[4] case in a male thirty-four years old. Nephrectomy was performed, and there was recurrence in the bladder a year later.

No. 7. Albarran's[5] case in a male thirty-four years old. There had been no recurrence at the time of the report which was written four years after the nephrectomy.

No. 8. Pantaloni's[6] case in a male forty-nine years old. Nephrectomy was performed, and recurrence took place six months later.

No. 9. Drew's[7] case in a male fifty-six years old, who died four months after nephrectomy.

We see on glancing at the list of cases that most of them had rapid recurrence.

The squamous cell epitheliomata are very fatal, most of the patients dying very soon after the operation. There is but one case in which recovery took place, that of Giordano[8], in a female fifty-seven years old, who had a nephrectomy performed. The woman was well six years later.

[1]Chir. Klin. der Nierenkrankheiten, 1901, p. 533.
[2]Les Tumeurs du Rein, Paris, 1903, p. 699, Case 34.
[3]Dtsch. Zeit, Chir., 1901, vol. 60, p. 15.
[4]Congrès Inter., 1900 Sect. de Chir. Urin., p. 78.
[5]See Heresco, Th. de Paris, 1899, p. 84.
[6]Arch. Prov. de Chir., 1899, vol. 8, p. 2.
[7]Tr. Path. Soc., Lond., 1897, vol. 48, p. 130.
[8]Ann. des Mal. des Org. Gén.-Urin., 1892, vol. 10, p. 585; and Chir. Renale, 1898, p. 215.

CHAPTER IV.

POLYCYSTIC KIDNEY

ETIOLOGY

The etiology of the disease is very obscure. The influence of heredity appears to be marked in some instances, and the affection is sometimes seen in members of the same family. The disease is one of middle life, and most cases occur between forty and fifty years of age. Seiber[1], in an analysis of a large number of cases, finds the following results:

20 to 29 years	26 cases.
30 to 39 years	22 cases.
40 to 49 years	67 cases.
50 to 59 years	40 cases.
60 to 69 years	10 cases.
70 to 79 years	6 cases.
80 to 89 years	2 cases.

A peculiarity of the disease is that it seldom occurs between the period of infancy and twenty-one years. Instance, however, occasionally do occur. Thus, Seiber[2] was able in a list of two hundred and twelve cases to collect thirty-three cases occurring during this period of life.

Boinet and Raybaud[3] give the following list of thirty-five cases occurring during infancy:

At term	14
8 mos	16
7 mos.	4
6 mos.	1
	35

[1]Dtsch. Zeit. f. Chir., 1905, 79, p. 469.
[2]Dtsch. Zeit. f. Chir., 1905, vol. 79, p. 471.
[3]Rev., de Méd., Paris, 1903, vol. 23, p. 4.

The disease has a tendency to affect women more frequently than men. Seiber, in a table of one hundred and ninety-eight cases in which the sex was given, found one hundred and sixteen females, and eighty-two males. It is curious to note that in the operative cases the proportion of females is much larger; thus, Seiber found sixty cases of women and ten cases of men in this class of cases. Albarran and Imbert[1] find the same result; in their list of operative cases there were thirty-five females and four males. There seems to be a slight preference for the left side, for in Seiber's[2] nine cases in which the disease was unilateral, the left side was affected six times, and the right side three times. Among his operative cases, also, this preponderance on the left side is noted, for in a list of forty-six cases in which operation was performed for this disease, twenty-eight times the left kidney was operated upon, and eighteen times the right one.

PATHOLOGY

Polycystic kidney is rarely seen in the adult. Preitz[3], on examining the records of the Pathologic Institute of Kiel, found among 10,000 autopsies only sixteen cases, or .16 per cent., of polycystic kidney. In the records of 2,429 autopsies occurring between the years 1896 and 1906 at the Boston City Hospital, there are ten cases, or .041 per cent., of polycystic kidney.

The tumor is made up of a greater or smaller number of cysts, which are scattered about in the substance of the renal parenchyma (Figs. 32 and 33). These cysts are of variable size, some being microscopic, and others from .5 to several centimeters in diameter, and even occasionally much larger. These larger cysts are formed by fusion of the smaller ones, and exceptionally they may hold from one to several ounces of fluid. The tumor usually preserves

[1] Les Tumeurs du Rein, Paris, 1903, p. 540.
[2] Dtsch. Zeit. f. Chir., 1905, p. 472.
[3] Der Freuenarzt, Leipsic, 1905, vol. 20, p. 490.

Fig. 32.—Polycystic Kidney in the Adult. Right Kidney, posterior surface. Weight of Kidney, 4370 grams. Dimensions: length, 32.5 cm.; width, 18 cm.; thickness, 12 cm. The patient's mother died of the disease. Case in the practice of Dr. H. T. Baldwin, Brookline, Mass.

Fig. 33.—Polycystic Kidney in the Adult. Right Kidney, anterior surface. Case in the practice of Dr. H. T. Baldwin, Brookline, Mass.

the characteristic shape of the kidney to a more or less degree, and sometimes attains to enormous dimensions. In a case of double cystic kidney, the details of which were communicated to the writer by Dr. H. T. Baldwin of Brookline, Mass., the right kidney weighed 4370 gms., measuring 33.5 cm. in length, 18 cm. in width, and 12 cm. in thickness; the left kidney weighed 5270 gms., and measured 34 cm. in length, 19 cm. in width, and 13 cm. in thickness. The mother of the patient had died from the same affection.

The cysts are closely packed together, invade every portion of the kidney, and viewed in the gross, give to the organ an appearance not unlike that of a bunch of grapes. Their number is variable, and they have a tendency to develop toward the anterior surface of the kidney, pushing the hilus toward the posterior part of the organ. The walls of the cyst are generally quite thin, and inside of them are sometimes seen the remains of septa which mark the places where coalescence with neighboring cysts has taken place. The contents of the cysts vary, being sometimes clear, pale, straw-colored, bloody, or dark brown. This fluid may be viscid, turbid, colloid, pea-soup like, serous, or limpid and transparent. The kidney substance between the cysts is compressed, and may be very fibrous or hyaline. In some instances there may be a very considerable increase in the amount of tissue. Occasionally the perinephric tissue is the seat of an abscess, and in these cases suppuration of the cysts has also taken place. The renal pelvis may become dilated, and when this occurs it is usually due to misplacement of the kidney, with torsion of the ureter and subsequent hydronephrosis. A fibrous change around the hilus of the kidney has also occasionally been observed, which is sometimes so extensive as to transform this portion into a fibrous mass. The growing tumor pushes the intestine in front of it, particularly the large intestine.

These tumors are most frequently bilateral in the adult,

as in the forms seen at birth. Lejars[1] found two cases among sixty-three adults in which the disease was unilateral. Seiber[2] in an analysis of one hundred and forty-nine cases found only nine in which the disease was unilateral.

Malformations of external organs in association with cystic disease in the adult are not so often seen, as in the case of polycystic kidney of the congenital variety, occurring at birth.

Under the microscope the cyst wall is seen to be made up of fibrous connective tissue, and it is lined with epithelium which in places appears to be undergoing proliferation; where this proliferation is most pronounced there is an appearance of papillary buds giving a distinct papillary appearance. The epithelium itself is cylindrical in places; in others is more flattened and cuboidal. The cyst wall is in direct contact with the parenchyma of the kidney, which it has altered in process of growth. Floating about in the cyst contents are numbers of epithelial cells, sometimes in enormous quantities. It was the presence of these large numbers of cells that first gave Brigidi and Severi[3] the idea that the process must be due to new growth as evidenced by proliferating epithelium. Urinary constituents are occasionally detected in these cavities, but never pure urine; urea, calcic oxalate, albumin, chlorides, phosphates, uric acid, cholesterin and leucin are found; the presence of a small quantity of blood is not exceptional. The renal parenchyma between the cysts has undergone great changes. Around the cysts there is localized nephritis, having the usual character of interstitial inflammation, and this change is especially marked in the region of cysts which are of large size, where compression has been considerable. Pictures of sclerosis and atrophy are likewise seen under the microscope, and evidences of inflammation of the arteries. The urinary tubules and glomeruli are greatly compressed

[1]Th. de Paris, 1888, p. 12.
[2]Dtsch. Zeit. f. Chir., 1905, vol. 79, p. 472.
[3]Lo Sperimentale, 1880, vol. 46, p. 23.

and atrophied. In advanced cases the interstitial tissue has taken on a dense appearance, in which nothing is to be distinguished but connective tissue in which renal elements are entirely absent. In areas where the cysts are not numerous and the compression not extensive, there may be renal tissue which is still capable of performing its physiologic function.

The interstitial changes in the kidneys are essentially those seen in ordinary cases of chronic interstitial nephritis. Secondary hypertrophy of the left ventricle of the heart, and likewise arteriosclerotic changes are very frequent in this affection, and occur in about three-fourths of the cases.

The occurrence of cysts in the liver at the same time with polycystic kidney has been noted in a number of instances. Cystic disease of the liver rarely occurs alone. Moschowitz[1] was able to find but ten cases in which the liver lesion was the only one; the others being associated with cystic kidney. Lejars[2] in a series of sixty-three cases found seventeen, five in men, and twelve in women, in which there was co-existing cystic disease of the liver. Seiber[3] found in his list of two hundred and twelve cases, thirty-nine which showed cystic liver; among these there were twenty females and eighteen males; while in one case the sex was not given. Cystic disease of other organs in association with polycystic kidney occurs much less frequently. In three of Seiber's cases both ovaries were affected; in three other cases, one ovary; in three cases, there were cysts of the choroid plexus; in one case, of the epididymis; in one case, of the broad ligament; in one case, of the uterus; in one case, of the bladder; in one case, of the ureter; in one case, of both ureters; and finally, in one case, of the renal pelvis and calices. Cystic change in the liver is seen particularly in adults, and almost never in infancy, at least not the microscopic form.

[1]Am. Jour. Med. Sci., 1906, vol. 131, p. 675.
[2]Th. de Paris, 1888, p. 21.
[3]Dtsch. Zeit. f. Chir., 1905, vol. 79, p. 488.

The walls of these liver cysts are formed of connective tissue lined with epithelium. The biliary canals in the neighborhood are also dilated, and it is possible to say, by studying a number of sections, that the cysts themselves might be due to dilatation of the canals, as all grades of dilatation are seen. These liver cysts are sometimes microscopic in size, and at others they are plainly recognized by the eye in the liver substance. They are not usually numerous, and do not, as a rule, interfere with the function of the organ. They may occasionally, however, be very numerous, and may even enlarge the liver to quite a considerable size. Lund[1] mentions the case in a female forty-seven years old. In this case there were double cystic kidneys of large size, and there was also cystic disease of the liver. The latter organ extended to 5 cm. below the border of the ribs, and was everywhere filled with cysts, some of which projected above the surface, and these cysts varied from microscopic size to 5 cm. in diameter.

The occurrence of these cysts in the liver at the same time with cystic degeneration of the kidney is strongly suggestive, at least, that they may have a similar origin. Albarran and Imbert[2] are of the opinion that these cysts develop at the expense of the biliary epithelium, and that the process is possibly that of new growth, an adenocystoma of the biliary passages. Suggestive of the theory that they may be due to malformation is the fact that independently of polycystic kidney they have been found associated with malformations of the body, though not so frequently as in the case of polycystic kidney. Convincing evidence that the liver cysts are due to congenital malformation has been furnished by Moschowitz[3], who describes the liver of a fetus which came under his observation. In this case there were double cystic kidneys, meningocele, and there were supernumerary fingers and toes. The liver was of normal size,

[1]Jour. Am. Med. Ass., 1906, vol. 47, p. 484.
[2]Les Tumeurs du Rein, Paris, 1903, p. 550.
[3]Am. Jour. Med. Sci., 1906, vol. 151, p. 687.

and contained no cysts; but on microscopic examination the organ was found to contain multiple primary *aberrant bile ducts*. These ducts were sometimes in masses and sometimes isolated, and each one was separated from the surrounding liver structure by a fine circular layer of fibrillar connective tissue. Moschowitz is strongly of the opinion that inasmuch as the fetus had other malformations, these aberrant bile ducts must be a congenital malformation, and he regarded these ducts as the first stage of cystic dilatation.

PATHOGENESIS

The pathogenesis of polycystic kidney in the adult is involved in great obscurity. This subject has given rise to an immense amount of speculation and discussion, and up to the present time no satisfactory conclusion has been reached. It would appear that the disease must have the same pathogenesis in the adult and in infancy, and yet there are features which are dissimilar at the two ages. The fact that the disease is so infrequent between infancy and the age of twenty-one makes it difficult to understand how it is possible that influences acting at birth can have any bearing on a disease occurring so many years afterwards.

It is certain that the cysts are the result of occlusion of pre-existing cavities. This appears to be so on examining these cysts; one finds in some of them evidences of dilated urinary tubules, and likewise dilated Bowman's capsules, as shown by remains of glomeruli in them. When we come to discuss the question how these cavities became dilated, and what influence was brought to bear to cause this dilatation, we are wholly in the dark, and are left solely with speculative theories. In the adult it seems fairly certain that in some cases at least the cysts do not date from fetal life. The cysts in the adult appear to develop in large part in the convoluted tubules; this appears to be the case from the fact that in the slighter forms of the affection most of the cysts are found in the cortex.

The following theories have been evolved to explain the pathogenesis of polycystic kidney in the adult: (1) the theory that the process is a new growth; (2) the theory that the process is the result of inflammation and sclerosis of the interstitial tissue between the tubules: (3) the theory that the process is due to a malformation,and consequently must be congenital; (4) and finally, there are some who combine these theories together, and who would explain the origin of polycystic kidney as the result of both malformation causes and subsequent tumor formation.

The theory of new growth was first conceived by Malassez[1], who called attention to the occurrence of polycystic disease with cystic disease elsewhere in the body, and although he brought no direct proof in support of the new growth theory, he was of the opinion that polycystic kidney was of the same nature as cystadenoma of the testicle and other organs. The theory gained no headway until the publication of an article by Brigidi and Severi[2]. These authors believed that the cyst contents were nothing else than the protoplasm of the epithelial cells fused together. The theory was, as already mentioned, first suggested to these authors by finding so many nuclei in the contents of the cysts. The phenomenon of nuclear division was also seen in many of the cells, and in numbers of them two nuclei were clearly evident. In other areas the tubules were filled with young elements, and in the smaller cyst cavities papillae could be seen covered with several layers of epithelium. The authors concluded that the kidney may have at first been affected by a formative irritation of the cellular epithelium of the uriniferous tubules; and that, succeeding this, degeneration of the new formed structures took place. They concluded[3] that the process finds its analogy in ovarian cystoma, and they compared the disease to the af-

[1]See Michalowicz, Dégén des Reins et du Foie, Th. de Paris, 1876, p. 23; and Malassez, Bul. Soc. Anat., 1877, vol. 52, p. 566.
[2]Lo Sperimentale, 1880, vol. 46, p. 23.
[3]Loc. cit., p. 24.

fection in the ovary, believing that in truth the affection in the kidney was a true cystoma.

Nauwerck and Hufschmid[1] next took up the theory, and related cases in which there was evidence of new growth. They found papillary projections filling the lumen of the tubules, which they considered to be the beginning of a papillary growth. The papillae were delicate and covered with epithelium. A further proof of the epithelial proliferation was found in the solid nests of cells which were easily recognizable as derived from the urinary tubules. These cell nests were not sharply marked out from the hyperplastic connective tissue. They appeared to be more frequent in the medullary substance, and were scattered irregularly through it; where two or three of them ran parallel they suggested the appearance of alveoli. Most of the cysts in their preparations showed well marked papillary structure, and the authors thought they were nothing more than proliferation of the tubules; some cysts were found which were almost entirely filled with these papillary ingrowths; finally[2] the authors thought there was proof that the epithelial nests might undergo cystic transformation. There were large irregular masses of epithelial cells lying in hyperplastic stroma, the epithelium of which was plainly arranged in lamellae and folds; in the central part of these cell nests the cells became separated from one another, and this the authors considered to be the beginning of cystic formation. In these cases the authors considered that the masses of proliferating epithelium formed collections of colloid material, which filled not only the smaller cysts, but the larger ones as well; they thought the cells must degenerate in a peculiar way, and that when desquamated they blended together, and finally formed larger colloid collections. The larger cysts were considered to be in some instances the result of coalescence of several smaller ones.

[1]Beitr. z. Path. Anat. u.z. Allg. Path., Jena, 1892-1893, vol. 12, p. 19.
[2]Loc. cit., p. 21.

Ritchie[1] in a careful study of the affection was strongly of the opinion that the process was one of new growth, and called attention to the budding processes in the early stages of the cyst formation. This author thought the disease in childhood and in adults entirely distinct, and he was inclined to believe[2] that the adult cystic kidney should be classed with the adenomata, while the congenital variety should be considered as an error in development. In Ritchie's[3] list of seventy-two post mortem examinations of polycystic kidney, cystic disease was found in the liver twenty-one times, in the thyroid once, in the uterus once, in the ovaries twice, in the ureters and bladder once, and in the pelvis of the kidney once.

Von Kahlden[4] also added weight to the theory of new growth, and was of the opinion that the microscopic appearances in cases of polycystic kidney were those of proliferation of the epithelium. This author corroborated Nauwerck's and Hufschmid's observations, and he also found papillary ingrowths and solid epithelial masses. This proliferative process was especially prominent in the papillary ingrowths found in the smaller cysts. In some of the larger cysts there was likewise papillary proliferation which showed exactly the same appearance as in adenocystoma of other organs, especially of the ovary. In some areas there was metaplasia of the epithelium into high cylindrical cells and papillary growths of the interstitial tissue, so that a structure was formed exactly similar to the peculiar structure of adenocystoma of the ovary. Von Kahlden was of the opinion that the histologic process lying at the bottom of all polycystic kidneys must be the same, in view of the very regular and always typical microscopic appearance. This speaks for the same origin of the kidney in the adult and in infancy. In discussing the origin of the liver cysts

[1]Lab'y Reports, Royal Col. Phys., Edin., 1892, vol. 4, p. 213.
[2]Loc. cit. p. 219.
[3]Loc. cit., p. 229.
[4]Beitr. z. Path. Anat. u.z. Alleg. Path., Jena, 1893, vol. 13, p. 305.

occasionally found with polycystic kidney, Von Kahlden believed there was no doubt that they represented adenoma or adenocystoma of the bile passages, and this confirmed in his mind the view that in the kidney the same process must exist.

Albarran and Imbert[1] found this theory very plausible. They admitted that the proliferating epithelium was not doubtful, and is shown in a variety of forms, as several layers of epithelium; bands of cells of epithelium, displacing the connective tissue; and papillae with a covering of several layers of cells. Furthermore, the presence of urinary constituents in some of the cysts, and in others of colloid material, without any relation with what remains of the normal urinary tract, made it certain that the epithelium secreted urine.

Busse[2] in discussing the origin of polycystic kidneys denied the possibility that they represented adenomatous tumors of the kidney, basing his opinion on the fact that the glandular elements are not increased, but are diminished, and on the fact that the tubules frequently disappear in a mass of connective tissue. Busse furthermore found the appearances described by Brigidi and Severi, and others, in embryonal kidneys. The "pseudo-papilliferous excrescences" on the inner wall of the cysts were thought by him to be chiefly abortive glomeruli.

The theory that the disease has been caused by inflammation of the interstitial tissue found its first exponent in Virchow[3], who was of the opinion that the cysts were true retention cysts, and that they resulted from occlusion of the urinary tubules in consequence of inflammation of the interstitial tissue in the papillae of the kidney, constituting a true condition of papillitis. Against this view is the fact

[1]Les Tumeurs du Rein, Paris, 1903, p. 556.
[2]Virch. Arch., 1904, vol. 175, p. 464.
[3]Verhandlungen der Phys. Med. Gesselschaft, Wurz., 1855, vol. 5, p. 458.—See also Krankhafte Geschwülste, 1863, vol. 1, p. 270—and Dtsch. Med. Woch., 1892, vol. 18, p. 35.

that papillitis is seldom found in infancy, and it is almost never seen in the adult. Petterson[1] performed some experiments on animals with the idea of demonstrating the effect of papillitis as a causative factor in the disease. He operated upon animals by splitting the kidney, and then passing a loop of silk through the papillae, leaving the ends free in the pelvis; then the kidney was sewed up. In every case[2] the tubules had been destroyed by a new growth of connective tissue, while the secondary changes resulting in the renal parenchyma were the same as those seen in hydronephrosis from occlusion of the ureter. There was first a dilatation of the tubules, which quickly reached the maximum and then receded; this was followed by a decrease in size of the entire kidney.

The occurrence of interstitial inflammation in cases of polycystic kidney, may, therefore, well be regarded as a sequence of the disease, and not a cause. The process is one of chronic interstitial nephritis, and while this is not to be regarded in any sense as an etiologic factor, yet its influence in augmenting the disease is not to be denied. There is nothing, however, to show that it is of itself a cause of the affection. Birch-Hirschfeld[3] called attention to the fact that in connection with inflammatory changes in the stroma there may be atypical proliferation of the older urinary tubules, with papillary formation, an analogy for which is found in the proliferation of the biliary passages in interstitial hepatitis.

The theory that the disease is in all cases congenital, and that it is due to some unxeplained process in fetal life in the nature of a malformation, has found many adherents. Koster[4] was the first to suggest this explanation of the origin of the polycystic kidney. The difficulty in accepting this theory for adult cases is the fact that for so long a period

[1]Beitr. z Path. Anat. u.z. Allg. Path., Jena, 1903, vol. 33, p. 606.
[2]Loc. cit., p. 616.
[3]Path. Anat., Spec., 1895, vol. 2, p. 848.
[4]Quart. Jour. Med. Sci., Dublin, 1868, vol. 46, p. 255.

of time between birth and adult life, the disease rarely occurs. We have seen that the disease has only exceptionally been found during adolescence. The fact that the disease occurs in many of the cases in members of the same family suggests some intra-uterine influence. On the other hand, malformations of other organs than the kidney are exceedingly rare in the adult, while they are not so uncommon in infancy.

Shattock[1] gave impetus to this theory, and expressed the opinion that the cavities were true retention cysts, originating in embryonic remains of the Wolffian body. Owing to his misconception of the embryology of the kidney he thought that there was persistence of the Wolffian body within the kidney; the Wolffian body he then thought became cystic, and in turn, by compression of the urinary tubules, caused cystic dilatation.

Busse[2] believed that the polycystic kidney both in infancy and in the adult is derived from disturbances of development; but in the *adult the grade of this disturbance must be slighter than in the congenital form.* In the adult the greater part of the kidney is formed in a normal manner, and there is arrest of development only in isolated places. This same author[3] believed "that in polycystic kidney we are dealing with an arrest of development, in the sense that perhaps, in consequence of an over-development of connective tissue, the urinary tubules and glomeruli cannot get into proper relation either with the ureter or with each other, and that each part develops independently in an abnormal way."

The malformation theory is a very attractive one. If we examine into the embryology of the kidney we shall see that there is good reason for supposing that malformation causes may be, in part, at least, the origin of the condition.

[1] Tr. Path. Soc., Lond., 1886, vol. 37, p. 287.
[2] Virch. Arch., 1904, vol. 175, p. 482.
[3] Dtsch. Med. Woch., 1904, vol. 30, p. 131.

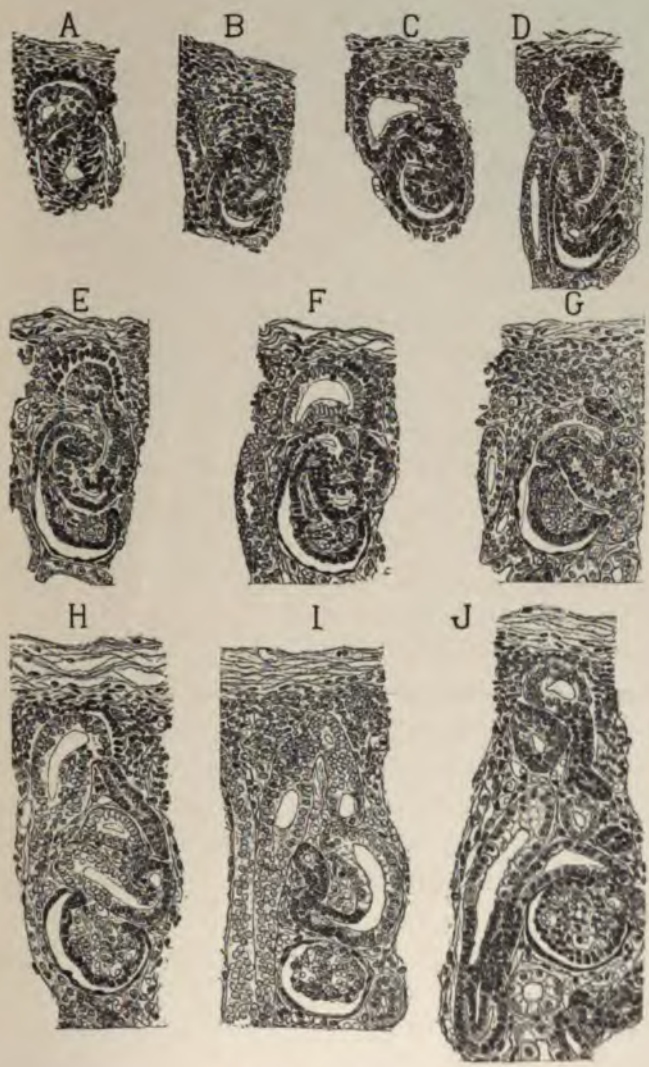

Fig. 34—A series of figures, A to J, of sagittal sections of tubular anlagen and uriniferous tubules in early stages of development, showing successive stages in the development of the uriniferous tubules, from a human embryo of the seventh month (X160). In each figure of this series there is reproduced the most typical section of the several series of sagittal sections used in making the reconstructions shown in Fig. 35. The corresponding tubules in Figs. 34 and 35 are designated by the same letter.
(From G. C. Huber; Amer. Jour. Anat., Supplement, 1904-5, vol. 4.)

Huber[1] has definitely shown that the fully developed tubule, that is, from its beginning in the glomerulus to its exit in the renal pelvis, is in the first instance formed from two separate structures (Figs. 34, 35, 36). In early embryonic life, there is formed a renal vesicle and a primary collecting tubule (Fig. 36, a and e). The vesicle is situated at the outer side of the tubule. Later, union takes place between these two structures with the formation of a single canal. The method of union is thus described: "There was observed in the tubular anlage or in the ampullar enlargement of the collecting tubule, at a stage which was recognized as just previous to a stage in which there is union of the two, a cell in mitotic division, or cells which by their structure and staining show that they had just completed division. This division of cells at the place of contact of the upper end of the tubular anlage and the ampulla of the collecting tubule, was associated with the fusion of these parts with the formation of a continuous lumen."

The diagrams illustrate this method of union. It is easy to see that if union failed to occur, a cystic condition might result in the tubule which did not have an outlet. As primary stages of polycystic kidney in the newborn are most frequently seen in the cortical portion where the glomeruli are situated, it would seem as though the theory that the affection resulted from non-union of the tubules had much to stand on.

These different views of the origin of the disease are confusing and there exists no uniformity of opinion.

The most plausible explanation seems to be that the disease may originate in consequence of embryonic malformation, and that subsequent neoplastic formation takes place. The interstitial changes and the compression caused by the cysts themselves still further tend to augment the size of the cysts.

Bunting[2] is inclined to believe that both malformation

[1]Am. Jour. Anat., Supplement, 1904-05, vol. 4, p. 17.
[2]Jour. Exper. Med., 1906, vol. 8, pp. 278 and 286.

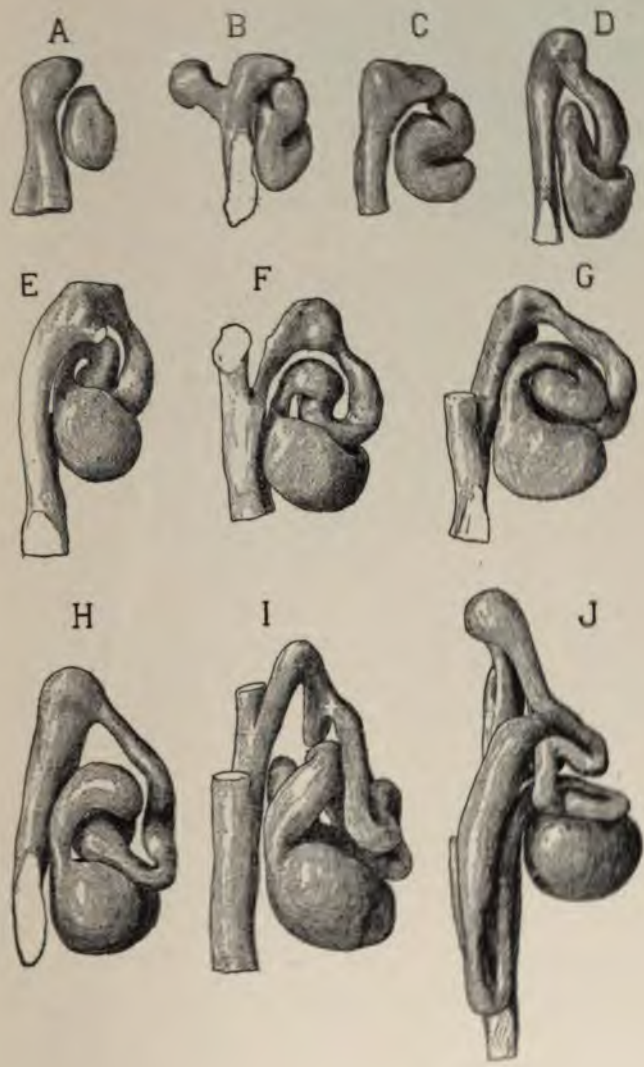

Fig. 35.—A series of models, A to J, showing successive stages in development of tubular anlagen and early stages in the development of uriniferous tubules, with a portion of the collecting tubule to which each is attached; from a human embryo of the seventh month (X160). (From G. C. Huber; Amer. Jour. Anat., Supplement, 1904-5, vol. 4.

causes and neoplastic formation are factors. Bunting had two cases of the disease in newborn infants of the same family. The specimens in each case were carefully examined. Not only were the kidneys affected with cystic dilatation but also the livers, and in one of the cases the pancreas as well. There was cystic dilatation of the ducts in

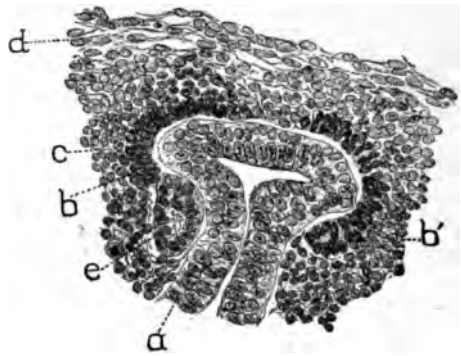

Fig. 36.—From a longitudinal section of a developing kidney of human embryo, 18 mm. in length (X233). a primary collecting tubule with ampulla; b, b', inner zone of metanephrogenic tissue; c, outer zone of metanephrogenic tissue; d, anlage of capsule; e, renal vehicle. (From G. C. Huber; Amer. Jour. Anat., Supplement, 1904-5, vol. 4.

the portal spaces and the ducts were tortuous and were surrounded by increased connective tissue. In the pancreas affected there was a similar hypertrophic condition of the duct epithelium and there was some increase in the connective tissue of the organ. There was no evidence in any of the organs of any interstitial inflammation such as might close the lumen of the ducts. Bunting[1] found little in the kidneys to give support to the theory that the cysts were due to failure to unite of the two sets of tubules, for he thought the glomeruli and the cortical tubules to be well formed and apparently normal in numbers. Bunting says: "If there were a failure of union one would expect a dilatation of the convoluted tubules and glomeruli, due to retained secretion. In these kidneys no such dilatation was found. The sole

[1]Jour. Exper. Med., 1906, vol. 8, pp. 278, 286.

malformation was an active proliferation of the epithelium of the collecting ducts of the medulla and of the junctional tubules in the cortex. Of such proliferation there was positive evidence in the numerous mitotic figures found in the epithelial lining of the cysts." The author thought that the process in the liver must be identical, "and this suggests the possibility that some of the cyst tubules in the labyrinth of the kidney cortex, which clearly showed a connection with the ducts of the medullary rays, but which much more rarely could be found to continue into tubules of the secreting type, were new-formed tubules analogous to those ducts of the liver which penetrated the lobule. The condition thus resembles a neoplasm, yet it is readily considered a malformation in the sense of an abnormal power of growth of the duct epithelium. If one accepts the Cohnheim theory for the origin of certain tumors in the congenital misplacement of tissue, an error in development, there is no sharp line between the two conditions." Bunting, however, is not willing to consider the tumor an adenocystoma, and he concludes by saying: "The position of the lesion in pathologic classification would seem to depend on the definition of terms. If it be a neoplasm it differs from the conditions usually included under that term. If it be a malformation it is one only in the sense of Couvelaire and Borst—a disproportionate activity in the growth of the epithelium. The frequent occurrence of associated malformations of other organs would appear to indicate that the condition bears a closer relation to malformations than to new growths."

Birch-Hirschfeld[1] is one of the chief exponents of the views of the double origin of the tumor. The proliferating epithelium and the papillary formations are thought by him to be sequences of this primary error in development, and these secondary changes to be true tumor formations in the nature of congenital cystic adenoma. Furthermore, Birch-Hirschfeld recognizes the influence that inflammatory

[1]Path. Anat., Spec., 1895, vol. 2, p. 848.

changes in the stroma may exert in causing atypical proliferation of the older urinary tubules, with papillary formation, an analogy for which is found in the proliferation of the bilary passages in interstitial hepatitis. Here also, as well as in other atypical epithelial proliferation of inflammatory origin, are found transitions into tumor formation.

Albarran and Imbert[1] believe in the double origin of the tumor and attach great importance to the influence of epithelial proliferation and retention in causing the cysts to enlarge. They do not attempt to explain what the nature of the malformation may be.

SYMPTOMS

The disease in very insidious in its onset. It may exist in latent form for many months, or even years, without giving rise to any symptoms whatever. A peculiarity of the disease is that in these insidious cases, with disease in both kidneys of a very extensive character, and with very little normal kidney tissue left, the patient may go on in a state of perfect health until suddenly symptoms of uremia come on, and death ensues in a short time. Another ending, unexpected and unforetold, is that by cerebral hemorrhage. Arteriosclerosis, a frequent accompaniment of polycystic kidney, is the cause of death in these cases. The patient may also die of some intercurrent disease, and on post mortem examination both kidneys may be found in an advanced stage of degeneration. Albarran and Imbert[2] estimate that the disease is an autopsy finding in twenty-five per cent. of the cases.

Milward[3] divides the history of this disease, for purposes of convenience, into three stages. The first stage is marked by the progressive enlargement of one or both kidneys, and during this time there may be no subjective symptoms whatever. The enlargement is discovered by accident,

[1]Les Tumeurs du Rein, Paris, 1903, p. 561.
[2]Loc. cit., p. 570.
[3]Birmingham Med. Review, 1904, vol. 56, p. 477.

if at all. This stage lasts from a few months to several years.

In the second stage subjective symptoms are experienced and objective signs are felt or seen by the patient or the physician in the majority of cases. The length of this stage is variable also, and it may last from a few months to several years.

In the third stage there are marked signs of decreasing elimination of urea, and uremic symptoms are not infrequent. This stage is the shortest, and lasts from two or three weeks to a few months, and ends in death.

Peculiar features mark the origin of the disease in some instances. Thus, Lejars[1] speaks of Schachmann's case, in which symptoms came on after drinking a large quantity of cold water; this was followed by severe vomiting, and persistent pain in the left side.

The tumor, although more fequently bilateral than unilateral, is in most cases felt only on one side. Lejars[2] in his series of sixty-three cases, noted tumor eighteen times only, and in these eighteen cases in only three of them was the tumor found on both sides during life, although in all of the eighteen cases there was double tumor. Ritchie[3], in a list of eighty-eight cases, reports tumor discovered during life in twenty-one. Of these cases, tumor was bilateral in eight cases only; it was found on the right side, in five; on the left side, five; twice, the side was not stated; and once, the tumor was in the epigastric region. When the tumor is bilateral the diagnosis is almost self-evident. It is rarely discovered during the period of adolescence.

The growth is sometimes of enormous size, and when both kidneys are affected the two tumors together may nearly fill the abdominal cavity. Compression of the intestines by the growth may interfere seriously with the function of the bowels.

[1] Th. de Paris, 1888, p. 37.
[2] Loc. cit., p. 47.
[3] Lab'y Reports, Col. Phys., Edin., 1892, vol. 4, p. 228.

On examination, the tumor gives a dull note between the ribs and the iliac crest, and, as the growth is not different in its physical characteristics from malignant growth of the kidney, the relation of the intestines is the same as in this disease. In thin subjects palpation will frequently discover the botryoidal character of the tumor, and it may be possible to discover the small irregularities due to the cystic enlargement on the face of the tumor. If the organ is displaced it may be possible to detect undue mobility, and this displacement is especially common in those cases in which there has been previous tight lacing. The growth often gives a characteristic soft yielding feel on palpation, but fluctuation is rarely present. Seiber[1] found fluctuation present in but twelve cases in his analysis. He mentions the possibility of fluctuation in certain portions of the tumor in which there may be large cysts, and thinks that this feature is of diagnostic importance.

Pain is the most prominent symptom in the second stage. It is usually of a dull, aching character, and it is felt in the lumbar region, and occasionally in the abdomen, at first on one side, but if the disease becomes bilateral, on both ides. The pain sometimes radiates to the iliac fossae, testicles, and lower limbs, and sometimes, though rarely, to the thorax. It is much less severe in the recumbent position, and physical exercise of any kind always aggravates it; under these circumstances it may have a sickening character. In the first part of the disease the pain is paroxysmal, but later on it may be continuous; this is explained by the fact that in the later stage of the disease the tumor drops into the abdomen, and occasions pain by the continual dragging upon its pedicle, in consequence of its great weight. Occasionally, the character of the pain resembles renal colic, and this has led to the erroneous diagnosis of calculus disease. It is probable that these colicky pains are caused by the passage of clots of blood through the ureter,

[1]Loc. cit., p. 475.

but they are especially prominent during an attack of hematuria. A sudden severe pain which lasts for a considerable length of time leads to the suspicion that there may be occlusion of the ureter, with resulting retention of urine; in such cases a hydronephrosis may be the result. This may occur particularly in those cases in which there is undue mobility of the tumor. Hemorrhages into the cysts may be the explanation of the severe pain sometimes felt, for examination of these kidneys removed at operation shows that the tension in the hemorrhagic cysts is very great. In a well marked case of polycystic kidney, pressure over the organ is very sensitive, and tight clothing cannot be worn. Sometimes the pain is a very late symptom. Thus, Luzzatto[1] records a case in which severe pain appeared only five days before death.

The other symptoms experienced during the second stage of the disease are mainly those which are due to the inefficient action of the kidneys, and to the general condition of arteriosclerosis which prevails in many of the cases. The typical clinical picture of polycystic kidney resembles very closely that of chronic interstitial nephritis, with this exception, that in polycystic kidney edema of the extremities is rarely observed. Ritchie[2] found only eleven cases in a series of eighty-eight, in which this symptom was recorded. When it does occur it usually begins in the hands and feet, and is seldom seen in the face. Ascites is also a rare symptom, and when it occurs it is usually caused by the mechanical pressure of the tumor. In the beginning of the second stage the symptoms are slight, and usually take the form of headaches, digestive troubles, flatulence, constipation, vomiting, and dyspnea, and at the same time there may be a slight increase in the amount of urine. This symptom should always lead to an examination of the kidney region. There may also be slight hemorrhages from the

[1]La Degenerazone Cistica dei Reni, Venice, 1900, p. 152.
[2]Lab'y Reports, Royal Col. Phys., Edin., 1892, vol. 4, p. 228.

nose, gums, and bowels, and petechiae may be seen on the surface of the body. A sudden cerebral hemorrhage may at any time occur, and cause death, or leave the patient in a condition of invalidism. The general health, however, may remain fairly good for a considerable period of time. Cardiac hypertrophy is not usually seen until late in the second stage, and with this hypertrophy general hardening of the arteries is frequently observed. These arteriosclerotic conditions account for such symptoms as those just mentioned.

The urine is generally acid in reaction, and it is usually slightly increased in amount, but sometimes it is diminished. In exceptional cases there may be marked polyuria, the amount being as high as 7000 c.c. in twenty-four hours. If the amount secreted is very large, there is dryness and roughness of the mouth and throat, with increased thirst. The specific gravity varies from 1008 to 1020. Sudden copious evacuation of urine leads one to suspect the emptying of a hydronephrotic sac, and this suspicion is strengthened if there is a sudden diminution in the size of the tumor. The amount of albumin in the urine is very slight, and there is seldom more than a trace. Albumin is present in about one-third of the cases. It is inconstant, and there are long periods of time when albumin is not present at all. Occasionally it is absent during the whole course of the disease. The quantity of urea excreted depends, of course, upon the amount of normal kidney substance spared by the disease. There are usually in ordinary cases between 15 and 25 gms. in the twenty-four hours. Casts are of rare occurrence, in this respect differing from the urine of chronic interstitial nephritis. Leucocytes are common, and are sometimes seen in large numbers. The presence of a large amount of pus indicates suppuration in the kidney. Blood in microscopic quantities is almost always present, and constitutes a significant sign. A severe attack of hematuria occurs, as a rule, every few months, or every few years, and is a prom-

inent symptom. Hematuria, however, does not possess the diagnostic importance that it does in malignant disease of the kidney. The occurrence of hemorrhage in polycystic kidney is often coincident with trauma in the lumbar region.

The third stage of the disease is very short, and is marked by symptoms caused by the gradually decreased elimination of urea. There may be violent headaches, severe dyspnea, drowsiness, convulsions, and coma. The character of the disease cannot now be in doubt. The patient usually has a yellow color similar to that caused by cancer, and there may be bronzing of the skin, not unlike that seen in lesions of the suprarenal capsule. The emaciation may be very pronounced; the patient's face is drawn and pinched, and his bodily strength is greatly reduced. Fever of the hectic type, while not a prominent symptom in this stage, has been noted a number of times. Death is frequently due to anuria with uremia. Luzzatto[1] records this ending in twenty-four cases in a list of thirty-eight in which the mode of death was given. Ascites and uncontrollable diarrhea may hasten the end by exhausting the system. Among other causes of death may be mentioned cardiac failure, acute pulmonary edema, pleurisy, bronchitis, bronchopneumonia, and pericarditis.

Among the complications of the disease, which may arise during any part of its course, may be mentioned suppuration of the kidneys, which is evidenced by increased pain, fever, excessive tenderness, and severe systemic disturbances; calculus, which in Seiber's[2] list of two hundred and twelve cases is mentioned eight times; hydronephrosis, which is present in a moderate degree in a considerable number of cases, and which seldom reaches large size, only four cases having been reported in Seiber's[3] list; and tuberculosis, which is frequently grafted onto the polycystic kidney.

[1]La Degenerazone Cistica dei Reni, Venice, 1900, p. 166.
[2]Dtsch. Zeit. f. Chir., 1905, vol. 79, p. 485.
[3]Loc. cit., p. 485.

The writer has seen a most unusual case of polycystic kidney affecting the right side, in a girl twenty-two years old, who had well advanced tuberculosis affecting the left kidney, which was not cystic. In such cases, the diagnosis having been made of tuberculosis, it is practically impossible to diagnosticate the true condition of the supposedly sound side, if there is only moderate enlargement and the kidney is secreting urine of fair quality (which conditions were present in the case mentioned), for the increased size of the supposedly sound kidney will be here thought to be due to compensatory hypertrophy.

It is difficult to estimate the duration of the disease from its beginning because it may be unrecognized for so long a time. The duration may appear to be very short, judging from the length of time that the symptoms are apparent, and it sometimes runs its active course within a few months. The disease may be recognized early, and may last a very long time; not infrequently cases have been reported in which the duration was ten or even twenty years. This is exceptional, and recognized cases rarely last more than five or six years.

When the disease has begun *in utero* the suspicion may be entertained that it is present by an unusually large size of the mother's abdomen. During labor it may be the cause of delayed birth, and instruments or some mutilating operation may be required before the child can be delivered. Premature labor is not uncommon. Boinet and Raybaud[1] in a list of twenty-five cases report twelve deaths immediately after birth, and ten soon after. If the child survives the symptoms noted are those due to pulmonary embarrassment, diarrhea, general exhaustion, and marasmus. The large tumor in the abdomen is suggestive of the diagnosis. The child leads a wretched existence until relieved by death. The end is usually by coma or convulsion.

[1]Rev. de Méd., Paris, 1903, vol. 23, p. 1.

DIAGNOSIS

The diagnosis of this affection is difficult in the first part of its course, when tumor alone is the first symptom. If there are two tumors, one on each side, the presumption is that the affection is polycystic disease, for, with very few exceptions, this disease is the only one which has a bilateral character. There is no difficulty in recognizing that the tumors are renal; they can be grasped bimanually, and their situation and mobility leave no question that they are enlarged kidneys. The entire absence of symptoms in so many instances serves to differentiate it in a measure from malignant growth, although, as we have seen, malignant disease may likewise remain latent for a considerable period of time without causing any symptoms; hematuria, however, is more apt to occur in malignant disease than in polycystic kidney. In the second stage the symptoms of renal insufficiency such as headache, vomiting, slight hemorrhages, etc., are extremely suggestive, especially in the presence of a tumor in the hypochondriac region. If the urine under these circumstances is increased in amount, has a low specific gravity, and possesses the other characteristics of chronic nephritis, this may lead to a correct diagnosis. The cardiac and arterial changes may likewise serve to indicate the character of the affection. In thin subjects it may be possible to outline the surface of the kidney, and appreciate its botryoidal character.

It seems strange that pregnancy should be mistaken for polycystic kidney, yet in the case of a very large abdominal tumor with amenorrhea, it will be seen that there may be some similarity between the two conditions, but a careful examination will soon clear up the obscurity.

Hydronephrosis and pyonephrosis are sometimes mistaken for this disease, but in these affections there is a sudden decrease in the size of the tumor when the sac is empty. A smooth tumer which fluctuates is very suggestive of distension of the renal pelvis, and this

feature is in strong contrast with the characteristics of polycystic kidney in which fluctuation is seldom evident. In pyonephrosis we look for evidences of inflammation in the lower urinary passages. Single renal cysts of large size may be very difficult to differentiate. The absence of general symptoms, except those due to pressure by the growth, may serve to distinguish between the two, single cysts of the kidney, even if of large size, seldom giving rise to such serious disturbances as are seen in polycystic disease of the kidney. Hydatid disease is exceedingly rare in the United States, although much commoner in foreign countries. The character of the tumor, and the usual symptoms of polycystic kidney, may differentiate these two diseases. Hooklets and scolices in the urine are positive evidence of hydatids.

PROGNOSIS

The prognosis is bad in all cases. The patient is always in danger of sudden death, either from sudden stoppage of the urinary secretion, or from apoplexy. Intercurrent diseases are likewise apt to occur, and if they do, the resistance of the body is much less than it is in sound constitutions. The disease has occasionally been observed in persons over seventy, and the presumption is that they harbored it a good while. Even after a successful nephrectomy there is grave danger of recurrence in the opposite kidney, and most patients succumb within a short time after this operation.

TREATMENT

Patients with polycystic disease take anesthetics very poorly, and one always hesitates to perform an operation if it can possibly be avoided.

Nephrectomy for polycystic disease should never be done unless it is certain that the opposite kidney has been found to be unaffected by the disease, and even in these cases nephrectomy is not to be thought of unless the tumor is caus-

ing severe disturbances. Symptoms of insufficient elimination of urea absolutely contraindicate the operation. Lejars'[1] statistics showing that the disease was unilateral in only two cases among sxity-three adults, show how seldom one will be called upon to decide whether nephrectomy shall be done. Ritchie's[2] figures are corroborative, and he found but two cases in a list of seventy-two in which at post mortem examination there was unilateral disease. In the presence of double cystic kidneys it may sometimes be permissible to do a nephrectomy if the more diseased side is bleeding profusely. Here one might be persuaded to take the risk of removing such a kidney, providing the disease on the opposite side were not too extensive, and there were no uremic symptoms.

Nephrectomy has been done in a number of cases, and sometimes with great success. An unfortunate feature is that after nephrectomy the disease is very apt to return in the opposite kidney, which is apparently sound at the time of operation.

Nephrectomy has been successfully performed in infants. Three cases have been recorded. Roswell Park[3] did the operation on a male child, twenty-three months old, in whom there had been a noticeable tumor for eleven months. The tumor, weighing four pounds, was removed and the child recovered. Death, however, took place some years later, in consequence of the same disease, which attacked the opposite kidney.[4] Dalle Ore[5] also had a successful case in a child thirty months old. The end result was not stated. Hildebrand[6] reported a successful operation in a case of congenital cystic kidney in a boy two years of age. There was no final history. The remarkable feature of this case was

[1]Th. de Paris, 1888, p. 12.
[2]Reports Royal Col. Phys., Edin., 1892, vol. 4, p. 229.
[3]Med. Press of Western New York, 1886, vol. 1, p. 475.
[4]Roswell Park: Modern Surgery, Phila. and New York, 1907, p. 969.
[5]Quoted by Boinet and Raybaud: Rev. de Med., Paris, 1903, vol. 23, p. 5.
[6]Arch. f. klin. Chir., 1894, vol. 48, p. 359.

the unique nature of the tumor. The cysts were perfectly typical, but the connective tissue between the cysts was invaded by sarcoma tissue with round cells, which in many places had penetrated into the cyst walls and were growing in the cysts themselves. This is a unique case.

The operation of election for nephrectomy is the abdominal, for it allows of a thorough exploration of the kidney supposedly sound. If this is found to be diseased the contemplated operation must be abandoned. It cannot always be foretold that the opposite kidney is unaffected, even by using the improved methods now at our command for estimating renal efficiency. An exploratory incision is practically devoid of danger, and it should be *insisted upon as it is the only means* of estimating the condition of the opposite kidney; slight degrees of cystic degeneration will alter the urine very slightly, if at all, consequently the diagnostic value of separated urines counts for little.

Albarran and Imbert[1] report thirty-four nephrectomies with twenty-five operative cures. Of these twenty-five patients the end results were known in fifteen. Two survived seven years; one, six years; four, three years, with probable recurrence; two, two years, with probable recurrence; one, twenty months, with probable recurrence; four, one year; and one died several weeks later. In Seiber's[2] tables there were sixty-two cases in which nephrectomy was done. In sixty-one of these the result was given. Twenty ended fatally, most of them immediately after operation. In forty-one cases the immediate result of the operation was favorable. In nine of these forty-one cases there was recurrence in the remaining kidney a short time following the operation. Of the remaining thirty-two patients, one was well five months after the operation; another, eight months; another, nine months; another, fourteen months; two, after two and a half years; four, after three years; one, after five

[1]Les Tumeurs du Rein, Paris, 1903, p. 576.
[2]Dtsch. Zeit. f. Chir., 1905, vol. 79, p. 495.

years; one, after six years; and two, after seven years; the remaining patients were not followed.

If it is not deemed best to do a nephrectomy an operation of great relief is that proposed by Curtis and Kammerer[1]. This operation consists of an incision in the lumbar region, evacuation of the contents of the large cysts, and suture of the cysts' walls to the deep fascia of the lumbar region. Harrison compares this operation to iridectomy for glaucoma. It is indicated when there is pain, and also when there are pressure symptoms. Occasionally it may prove very beneficial by anchoring a movable polycystic kidney, thus preventing dragging on the pedicle. Lund[2] reports the case of a woman who was operated upon in this way, who had permanent fixation of the kidney several months after the operation, in spite of a very bad fall down stairs a little while after the operation was done. The operation may likewise prolong life in the case of sudden anuria by relieving pressure on the renal parenchyma unaffected by the disease.

[1]Ann. Surg., 1901, vol. 34, p. 419.
[2]Jour. Am. Med. Ass., 1906, vol. 47, p. 483.

CHAPTER V.

SIMPLE SEROUS CYSTS OF THE KIDNEY

Simple serous cysts of the kidney are exceedingly rare. Their relation to polycystic disease is not altogether clear, and there is some ground for thinking that the two may have a similar origin. Simple cysts, however, are almost invariably unilocular, and their removal is almost never followed by recurrence. The affection is benign, and but one kidney is attacked; in this respect simple serous cysts differ radically from polycystic disease.

ETIOLOGY

The affection generally attacks persons in middle and advanced life, and is particularly common in women.

PATHOLOGY

Simple serous cysts must be distinguished from the cysts which are frequently found in chronic interstitial nephritis. The cysts in sclerosed kidneys are plainly due to obstruction of the urinary tubules in consequence of inflammatory processes, and this obstruction leads to dilatation of the part above, in consequence of the accumulated urine. Large serous cysts occuring in chronic interstitial nephritis resemble the serous cysts to a marked degree, and it is only when there are associated interstitial changes that it is possible to differentiate them. In the autopsy records of the Boston City Hospital there are two cases[1] in which there were large cysts in kidneys affected by arteriosclerosis; in the first case the cyst was as large as a small orange, and in the second it equaled the size of a fist.

[1]Autop. Rec., Nos. 96.174 and 96.82.

Simple serous cysts usually project above the surface of the kidney, and at the base of the cyst there may be a thin layer of kidney tissue where stretching has taken place. At times there is a communication between the cysts and the renal pelvis. The cysts vary in size from a few centimeters to a large sac which fills the abdominal cavity. In a case reported by Morris[1] one of these cysts involving the lower part of the kidney filled the abdominal cavity, and the contents weighed sixteen pounds; it was filled with a dirty brown fluid and discolored blood clot. The shape is usually rounded, but sometimes it is more or less fusiform.

The cortex is generally the seat of the origin of the cysts, but sometimes they arise in the medullary portion of the kidney. It is probable that a single large cyst may in some instances be due to the coalescence of several smaller ones. Beyond the limits of the kidney the cyst wall is quite thin, and may be even transparent; on its surface are the blood vessels, veins and arteries, which are branches of the renal vessels. In some instances the cyst is quite thick, and may be even semi-cartilaginous in places. The relations with the parenchyma of the kidney are very close. The fluid in the sac is usually colorless, quite clear, and, as a rule, urinary constituents are absent; a little albumin is occasionally found. If hemorrhage occurs, the fluid assumes a bloody color, and subsequent changes may lead to the formation of thick colloid masses. The kidney tissue in the neighborhood of the cysts suffers from changes due to pressure, and there is evidence of atrophy; the kidney as a whole retains its normal character and is not affected. These cysts have been known to rupture internally, and when this occurs the fluid penetrates the surrounding tissues and inflammation results.

Nothing is known as to the mode of origin of these cysts. It is probable that they are due to retention, but from what cause, is not evident. It seems probable that they are formed at the expense of pre-existing cavities.

[1]Tr. Path. Soc., Lond., 1871, vol. 22, p. 171.

SYMPTOMS

The symptoms of this disease are ill-defined and obscure. Small cysts rarely give rise to any symptoms whatsoever, and they are usually autopsy findings. The functions of the kidney are rarely interfered with, even if the cyst is quite large, and the part of the kidney unaffected by the disease is usually found to be unaltered. The growth of the cysts is quite slow, and this slow growth accounts in part for the absence of symptoms, for the surrounding organs have had opportunity to accommodate themselves to the new conditions. Pain is absent in the majority of cases. Occasionally, however, it is a marked symptom, as in Recamier's[1] case in a female fifty-nine years of age, in which the tumor growing from the superior pole of the kidney gave rise to an attack of excruciating pain in the lumbar region, accompanied by intense vesical tenesmus with a desire to urinate. An immediate operation was necessitated, and a cyst containing 200 cubic centimeters of clear fluid was removed, and the symptoms subsided. Recamier explains the pain in this case as due to the crowding down of the kidney, and he is of the opinion that if the cyst had been in the lower pole of the kidney the pain would not have been felt. It is rarely that pain as severe as this is experienced, and the discomfort is rather that of a dull, aching character, and a sensation of weight, which is increased after exertion.

Tumor is seldom seen in the beginning, and it is frequently an accidental discovery. It forms a mass, easily appreciated, in the lumbar region, which may fluctuate, and give a dull note on percussion. The kidney and the tumor may be movable together, and if this is so, the mistake may be made of diagnosing hydronephrosis in a movable kidney.

Unusual symptoms, such as dyspnea, edema of the lower limbs, hematuria, and frequent micturition, may sometimes occur, but they are very rare.

The urine usually remains unaltered throughout the

[1] Ann. des Mal. des Org. Gén.-Urin., 1893, vol. 11, p. 187.

course of the disease. In some cases there are attacks of hematuria, but this is a rare symptom.

If the tumor begins to grow and becomes very large, symptoms referable to pressure and weight assume prominence. These symptoms are the usual ones seen in large growths in the abdominal cavity; they are nausea, and vomiting, general weakness, prostration, cardiac symptoms, debility, emaciation, dyspnea, edema, etc. A serious complication which sometimes happens is suppuration of the cyst cavity. In such cases the systemic disturbances are severe.

DIAGNOSIS

The diagnosis of simple serous cysts of the kidney is rarely made before operation. Small cysts readily escape observation, and if they are found by accident they are easily mistaken in the absence of symptoms for other symptomless growths in the abdominal cavity. When fluctuation is present hydronephrosis may be difficult to differentiate; here, however, ureteral catherization will, in the case of hydronephrosis, obtain a urine which is more or less altered from the normal. The location of the tumor in the lumbar region is suggestive of renal growth. When the tumor is of large size the disease most frequently mistaken is ovarian cystoma. Tuffier[1] in a list of thirty-eight cases records that the tumor was taken for ovarian cystoma in twelve instances.

TREATMENT

In the early stages of the disease, before the tumor has reached a large size, curative operations are comparatively simple and beneficial, but if the tumor has been allowed to grow there are grave dangers attending operations for removal.

The condition of the patient may preclude a serious operation which involves extensive dissection of the cyst wall,

[1] Arch. Gén. de Méd., 1891, 7. s., vol. 28, p. 5.

and in these cases it is best to incise the cyst extraperitoneally through a lumbar incision, evacuate the contents, and sew the edges of the incised cyst to the deep layer of the lumbar fascia. The objection to this operation is that although the urgent symptoms are immediately relieved, yet there is danger that a permanent fistula may result. Tuffier, in his careful study of this disease, records three cases out of six, in which an intractable fistula resulted from this operation. A modification of this operation is to cut away as much of the cyst wall as possible, destroy the surface of the cyst with some caustic, such as carbolic acid, and suture the shortened edges of the part remaining to the deep layers of the lumbar fascia. Drainage is, of course, necessary.

Nephrectomy should be avoided if possible. Every effort should be made to save the remaining part of the kidney unaffected by the disease, because it is normal tissue. Besides this the dangers of the operation are greatly increased by removal of the kidney. The opposite kidney has presumably not become hypertrophied, and may not be able to assume the burden of the extra amount of work suddenly thrown upon it. Tuffier[1] records eleven deaths, or forty-five per cent., in twenty-four cases in which nephrectomy was done. These cases include many in which operation was performed many years before. Within the past ten years the technique has so much improved that the mortality is not so great. Thus, Albarran and Imbert[2] record seven cases without a death, in which operation was performed within the past ten years. Nephrectomy may be required in some cases, however, particularly in those in which the blood vessels of the kidney are intimately related with those lining the cyst wall; in such cases it may be very difficult, if not impossible, to dissect the cyst wall from this part of the kidney, and it may be safer to do a nephrectomy if the general

[1] Arch. Gén. de Méd., 7. s., vol. 28, p. 7.
[2] Les Tumeurs du Rein, Paris, 1903, p. 507.

condition of the patient permits. If most of the kidney has been destroyed it is best to remove it with the cyst.

The operation of election is incision, evacuation of the cyst contents, and careful subperitoneal dissection of the entire cyst wall down to the kidney; when the kidney is reached the dissection of the cyst wall should be carried on so as to separate it entirely from the renal parenchyma; it will not peel out as many forms of tumor do, but must be dissected out; the raw kidney surfaces are then joined together by means of sutures and the abdomen closed. This operation was first proposed by Tuffier[1], who first carried it out to a successful issue. There is little danger of hemorrhage by using this method, for even if bleeding is at first severe on the part of the kidney, it will soon cease on applying a little pressure. The chief difficulty is the separation of the cyst wall from the peritoneum, and there is considerable danger of tearing the peritoneum. The method is applicable for both large and small cysts, especially the latter. The small ones may be removed through a lumbar incision, but large ones will have to be attacked through an abdominal incision.

Partial nephrectomies are relatively favorable. Albarran and Imbert[2] record five cases in which recovery took place. Resection of the wall of the cyst, with suture of its edges to the lumbar incision, is also a relatively benign operation.

The disease is benign in its nature, and if the cyst is removed early the patient will probably recover without further complications. It is only when the cyst is of large size that the patient's life is in danger. In these cases the secondary complications are the cause of death.

[1]Gaz. Hebdom. de Méd. et de Chir., 1897, n.s., vol. 2, p. 1135.
[2]Loc. cit., p. 507.

CHAPTER VI.

PERIRENAL TUMORS

ETIOLOGY

These tumors are of rare occurrence. Gurlt[1], in an analysis comprising 14,630 tumors examined at Vienna, of which 894 were sarcomata, found only one sarcoma of the retroperitoneal space. Hartmann and Lecène[2] in a list of thirty-three cases found tumor sixteen times on the right, and eleven times on the left; only once was it bilateral. Rambaud[3] in an analysis of one hundred and two cases found sixty-nine women and thirty-three men. In sixty-six of these cases the age was given, and it was found that the disease occurred most frequently between the ages of thirty and sixty.

Adami, in a list of forty-two lipomata affecting the retroperitoneal space, found the complaint more common in females than in males, in a proportion of 25 to 16; in his cases both sides were affected with equal frequency, and the disease was found most common in middle and later life.

The disease is of extreme rarity in children. Neumann[4] has recorded a case in a boy, three years old, who had a lipoma of the retroperitoneal space, weighing seven pounds, which was removed by operation. The child had had an enlarged abdomen since the age of thirteen months and was thought to be suffering from tubercular peritonitis. Recovery followed the operation and the health was good five months later.

[1]Quoted by Rolleston and Turner, London Lancet, 1901, vol. 1, p. 1275.
[2]Travaux de Chir., Paris, 1903, p. 57.
[3]Th. de Toulouse, 1903, p. 247.
[4]Arch. f. klin. Chir., 1905, vol 77, p. 413.

PATHOLOGY

Perirenal tumors are found under the peritoneum in the region of the kidney and ureter, in close relation to these structures.

The tumors are solid and cystic. The solid tumors are lipoma, fibroma, sarcoma, and mixed tumors. The first three are frequently combined with other elements, and the resulting tumor may be myxolipoma, fibromyxolipoma, fibromyxoma, fibrosarcoma, myxosarcoma, lymphosarcoma, etc. The mixed forms are sometimes quite complicated, and are very rare. They are analagous to the mixed tumors of the kidney, and may contain bone and muscle fiber. Finally, an adenocarcinoma has been described[1].

These cysts are found: (1) cysts developing from fetal remains of the Wolffian body; (2) serous cysts; (3) hydatid cysts; (4) blood cysts; and (5) cysts of peritoneal origin. The hydatid cysts will be discussed elsewhere.

The frequency with which solid tumors occur may be inferred from the following figures by Hartmann and Lecène[2]. In thirty-three cases there were six lipomata, four fibrolipomata, nine fibromyxolipomata, two fibromata, three fibromyomata, five fibrosarcomata, two angiosarcomata, and two mixed tumors. In a list of fifty-four cases of solid tumors of the perirenal tissue, Albarran and Imbert[3] found twenty-two tumors belonging to the lipoma class, of which six were lipomyxomata; twelve were either pure lipomata or fibrolipomata; three were fibromyxolipomata, and one myxoma. Sarcomata are much commoner that the fibromata. Albarran and Imbert[4] in a total of fifty-four tumors found seventeen of the sarcoma class. Among them were examples of pure sarcoma, fibrosarcoma, angiosarcoma, fibrocystosarcoma, and lipomyxosarcoma. The mixed tumors are exceedingly rare, and, contrary to the peculiarity

[1]See Rambaud, Th. de Toulouse, 1904, p. 257.
[2]Travaux de Chir., Paris, 1903, p. 59.
[3]Loc. cit., p. 586.
[4]Loc. cit., p. 587.

of mixed tumors of the kidney, which are relatively common in children, we find that this is not the case in the perirenal variety, for the mixed tumors are commoner in the adult. Adami[1] found, in a list of forty-two lipomatous tumors affecting the retroperitoneal tissue in general, that one-third of them had origin around the kidney. Steele[2], in a list of forty-five cases of sarcoma affecting the retroperitoneal space in general, found that the tumor originated in the lumbar region in fifty-seven per cent. of the cases. Mixed tumors are exceedingly rare, and Albarran and Imbert[3], in their list of fifty-four cases, found only six of this variety.

The solid tumors of the perirenal tissue arise from the capsule of the kidney, or from the tissue underneath the peritoneum. In this situation connective tissue prevails, consequently, tumors arising from it are connective tissue tumors. The growth sometimes arises in the mesentery, and this is especially true of lipoma; it may start in the mesocolon on either side, or it may originate in the fatty capsule of the kidney. When it arises in the mesocolon it may extend into the region of the kidney, and it is then impossible to tell what its point of origin has been. Occasionally the transverse colon passes across the tumor, and when this occurs it is evidence that the growth originated in the mesentery. The origin of sarcoma, in at least two-thirds of the cases, is the capsule of the kidney, and cases are not wanting in which the origin has been the connective tissue around the ureter. The tumor may be encapsulated or diffuse, and its relations with the kidney are always very close. The kidney is more or less imbedded in the growth, and may be flattened or displaced; the organ may be so much imbedded that it may be impossible to enucleate it at operation, although adhesions between it and the growth may be very slight; in these cases it may be necessary to remove the kid-

[1]Montreal Med. Jour., 1896-1897, vol. 25, p. 621.
[2]Am. Jour. Med. Sci., 1900, n.s., vol. 119, p. 324.
[3]Loc. cit., p. 588.

ney with the growth. Infiltration of the organ itself rarely takes place, except in the case of sarcomata. If the pressure has been long continued there may be secondary atrophy of the renal substance. The ureter may pass in front or behind the growth, and it is rare that it is not pervious; occasionally, however, obstruction occurs, and back pressure from accumulated urine results. When the tumor is on the right, the liver may be compressed, and when on the left, the spleen.

Adhesions to surrounding organs depend in great measure on the variety of the growth. Sarcomata are particularly apt to be associated with dense adhesions, and this, of course, increases the operative difficulty in removing them. Fibromata likewise are apt to have denser adhesions than lipomata; the latter tumors appear to be the least adherent of all. Intestinal adhesions are the most important, and if dense, they may constitute a serious difficulty at an operation.

Secondary changes are common in perirenal tumor, and chief among these changes is necrosis, which may occur in the center of the growth, and which is due to insufficient blood supply; this necrosis is most apt to occur in the large growths, and, as a result, a cystic cavity is formed, which may be filled with purulent fluid. Among other changes may be mentioned osteoid and cartilaginous changes, and a deposit of calcareous salts. Fatty degeneration is also seen in sarcomatous tumors.

Perirenal growths sometimes attain to an enormous size. The largest one on record is that reported by Waldeyer[1], which was a myxoliposarcoma, weighing sixty-three pounds; in this case there were metastases in the lungs and liver. It is not unusual for these growths to attain to twenty, thirty, or even forty pounds in weight. The lipomata particularly sometimes reach a very large size. Sarcomata may not reach the large size that lipomata do, but they do

[1]Virch. Arch., 1864, vol. 37, p. 543.

not fall far behind in this respect. Fibromata are the least apt to reach a very large size, but they weigh a great deal on account of their density. Cases have been reported in which fibroid tumor reached the weight of nearly fifty pounds.

The tumors in general are apt to be made up of a greater or less number of lobes of various dimensions; this is particularly true of the lipomata. The consistency is variable according to the nature of the growth; soft when a lipoma, elastic and hard when a fibroma or sarcoma.

The relation of the tumor to the large intestine is of considerable importance. Hartmann and Lecène[1] in an analysis of thirty-three cases mentioned the relation of the tumor to the large intestine. The ascending or descending colon is usually pushed in a forward direction by the tumor. This may result from the retroperitoneal position of the growth. The tumor, however, is apt to present more on one side or the other of the colon, and this relation is important in operating. On the outer side of the growth lies the abdominal wall, and consequently this part will present an area of flatness on percussion.

Lipoma does not differ in histologic structure from lipoma elsewhere, and it is apt, as already mentioned, to be associated with tissues of other kinds. The tumor is lobulated, especially when of large size, and this lobulation renders operation for removal of the tumor a matter of considerable ease. Pure lipoma must be distinguished from the occasional large collections of perirenal fat so frequently seen in long-standing diseases of the kidney, such as calculus and tuberculosis.

Sarcoma is found in a number of different forms; the small round cell, the large round cell, the giant cell, the spindle cell, the lymphosarcoma, the fibrosarcoma, the myxosarcoma, the angiosarcoma, and the myxosarcoma cavernosa. These forms do not differ in their finer histologic structure

[1]Travaux de Chir., Paris, 1903, p. 57.

from those found elsewhere in the body. These tumors may be extremely vascular, and on this account, as well as on account of their usually dense adhesions, operation for their removal is attended with considerable risk. They are, therefore, decidedly the most dangerous of all the forms of tumor of the perirenal tissue. Hartmann and Lecène[1] in an analysis of nine cases of sarcomatous growth found no metastases; but this cannot be said to be the invariable rule, because metastases have been found by other observers, and, as an instance may be mentioned Waldeyer's[2] case, in which a myxoliposarcoma, weighing sixty-three pounds, gave origin to metastases in the liver and lungs. Steele[3] is of the opinion that metastasis is quite common in this form of growth.

Fibroma is seldom found in the pure form, and usually occurs as fibromyoma, or fibromyxoma. These tumors are usually quite vascular. Albarran and Imbert[4] in a list of fifty-four cases found only nine tumors of the fibroma class.

Cysts of the perirenal tissue are of extremely rare occurrence. Morris[5] in a series of 2610 post mortem examinations at the Middlesex Hospital in London during a period of ten years, found only a single case of cyst of the perirenal tissue. This occurred in a woman seventy-five years of age. Albarran and Imbert[6] in a list of seventy-two perirenal tumors found sixteen cysts of various sizes.

The cysts are always unilocular, and affect one side alone. A single instance of multilocular cyst has been recorded by Albarran[7]; that was in a child two months old, affected with a polycystic tumor of the perirenal tissue. The growth weighed a little more than a pound, and was situated in front of and below the right kidney. The mass con-

[1]Travaux de Chir., Paris, 1903, p. 60.
[2]Virch. Arch., 1864, vol. 37, p. 543.
[3]Am. Jour. Med. Sci., 1904, n.s., vol. 127, p. 952.
[4]Loc. cit., p. 587.
[5]Surg. Dis. of Kidney and Ureter, Lond., 1901, vol. 2, p. 40.
[6]Loc. cit., p. 589.
[7]Bul. et Mém. de la Soc. de Chir. de Paris, 1903, vol. 29, p. 117.

sisted of numberless small cysts from the size of a pin's head to that of a cherry.

The origin of cysts of the perirenal tissue is to be sought in embryonic remains of the Wolffian body[1]. These remains may be found in any part of the perirenal or periureteral space, and consequently the tumor must arise either around the kidney or the ureter. Rambaud[2] gives a new theory of origin for these cystic growths, namely, an embryonic peritoneal origin. He thinks that sequestered cavities in the depth of the tissues, which are due to non-adhesion of the peritoneum, which normally should take place, are the origin of some of these cysts; and the low epithelium lining the internal wall of the cysts would seem to carry out this view.

The cysts may sometimes reach an enormous size, and they may contain several quarts of liquid. This liquid is an albuminous fluid which is clear, very watery, sometimes colorless, and occasionally yellowish; uric acid and urea have been found in this fluid. The cyst wall is quite thin, as a rule, and occasionally it ruptures, discharging its contents into the peritoneal cavity. Adhesions of the cyst wall to surrounding structures are almost never seen, and this makes removal comparatively easy.

SYMPTOMS

The chief characteristic of all growths of the perirenal tissue, with the exception of the sarcomata, is their slow development. The tumor is frequently discovered by accident, and up to that time it has possibly given no symptoms whatever which call attention to it. The general health suffers very little during the whole course of the disease, except toward the end; during the latter part of the trouble there is marked emaciation and loss of bodily strength. The duration of the disease from the beginning is usually two or three years in the case of the more benign growths, but in

[1] See Lockwood, Tr. Path. Soc., London, 1898, vol. 49, p. 185.
[2] Th. de Toulouse, 1903, p. 263.

the case of sarcoma the time is much shorter, eight months being the average duration. As the disease progresses and causes pressure in consequence of its size, symptoms referable to the various organs which are pressed upon, assume prominence. Chief among these is dyspnea, and this constitutes the real and principal cause of suffering. As the tumor grows larger it causes embarrassment on account of its size; the patient finds it difficult to get about, and his shortness of breath incapacitates him from the daily duties of life. Pain is occasionally the first indication of the trouble, but in three-fourths of the cases the first symptom is tumor. As a rule the digestion is not interfered with, except toward the end of the disease. Constipation may occur, and when it does it is usually caused by pressure. Edema is sometimes a symptom, and is due to pressure on the blood vessels. Pulmonary edema has been noted, but this is one of the late manifestations. Among other symptoms may be mentioned varicocele, creeping and burning sensation of the skin of the abdomen, subumbilical colic, pain in the back, with radiation to the testicles, and various nervous phenomena. The function of the kidneys is not usually interfered with, hence the amount of urine may be normal, and microscopic examination will show no deviation from the usual condition. There may, however, be an associated nephritis. Cystic disease presents in the main the same symptomatology as that of the benign solid tumors; its evolution, however, takes longer, and may extend over a period of several years.

In sarcomatous disease the earlier manifestations are apt to be more severe, and are usually of a functional character, the digestive tract being especially affected. Later in the course of the trouble, pain which is due to pressure on the lumbosacral nerves assumes prominence. In all cases of perirenal tumors the termination of the disease, unless operation is performed, is usually due to exhaustion.

On examination, the tumor will be found, as a rule, to be

irregular in shape, but this is by no means constant. The consistency varies according to the nature of the growth; the lipomata are usually quite soft, and fluctuation is not unusual. Morris[1] found fluctuation in seven out of fifteen cases of lipoma. Dulness will be made out in the flank, and this dulness extends backward to the spinal column. There will be an area of tympany over the growth if the intestine can be mapped out over it, and this usually can be done. If the colon does not run across the growth, dulness will be discovered all over it, and in these cases particularly there is great difficulty in differentiating an ovarian tumor. In the examination it is well to remember that these tumors are frequently lobulated. When of small size the growth may be movable, but when larger, the position is usually fixed.

DIAGNOSIS

It is extremely difficult to make a correct diagnosis of a tumor of the perirenal space. In the vast majority of cases merely a provisional diagnosis can be made. The points indicating the disease are slow, usually painless, growth, with absence of urinary symptoms, the growth sometimes developing to a tumor of large size and filling the abdominal cavity. Occasionally a history may be obtained showing that the tumor began in the lumbar region. This history, however, is not characteristic, and barring the feature that the growth began high up, the history is also characteristic of ovarian tumor. The presence of intestine on the anterior surface of the growth is suggestive, and this sign may be made prominent by inflation of the bowels with air.

The preceding symptoms are so characteristic of other abdominal tumors that they really furnish very little diagnostic help. The feature which may be most relied upon is tumor in the the renal region not accompanied by changes in the urine. A differential diagnosis between the cysts and some of the solid forms cannot usually be made. The lip-

[1]Surg. Dis. of Kidney and Ureter, Lond., 1901, vol. 2, p. 34.

omata frequently give rise to a sense of fluctuation, as has already been observed, and other forms of growth which have become softened in the interior will also give rise to a sense of softness amounting at times to fluctuation. The only feature characteristic of cystic disease is its usually longer course, and its rather milder symptoms. It is quite impossible to differentiate between cysts of the adrenal and cysts of the perirenal tissue.

Sarcomatous disease has a much more rapid course than that of the more benign growths, and we have seen that pain usually begins early in the course of the trouble.

The diseases most frequently confused are ovarian tumor, renal and suprarenal tumor, ascites, tumor of the liver, mesenteric tumor, pancreatic cyst, and hydronephrosis.

Malignant disease of the kidney is very difficult to differentiate; with renal growth, however, we usually have hematuria. Pain due to renal growth is also apt to be very severe, and may arise early in the course of the disease. The same is true with reference to adrenal tumor, in which the pain may come on still earlier. In cases of malignant disease, in which there is no hematuria, the differential diagnosis is well-nigh impossible.

The most frequent source of error is mistaking the enlargement for an ovarian tumor. In the beginning of ovarian trouble this would not hold, except in cases in which the perirenal tumor began well down in the course of the ureter. The occurrence of menstrual difficulties is significant. Furthermore, in ovarian disease the tumor may be limited circularly by a zone of tympany.

Ascites may be eliminated by careful attention to the details of the case, and by watching the patient. Hydronephrosis, in the majority of instances, has a characteristic history of crises of pain, and the intermittent character of the enlargement is also significant. Tumors of the liver are frequently confused, and it may be impossible to differentiate them. Symptoms referable to the obstruction to the

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flow of the bile are significant here, and so also is the fact that hepatic tumors are continuous with the liver substance. Pancreatic cysts are tense and hard, and usually lie behind the stomach. As a rule, they are small in size; the large ones are usually impossible of differentiation. A perirenal cyst extending to the middle line of the body under the perirenal fascia may closely simulate pancreatic cyst.

TREATMENT

The treatment is operative, and the earlier the operation is done the more chance the patient has for ultimate recovery. The usually painless character of the trouble is a temptation, on the part of the patient, to delay operation until the disease has assumed proportions of magnitude.

The chief danger during operation is from hemorrhage. The vascular supply is sometimes very considerable, especially in the malignant forms, and there is a possibility of sudden death from hemorrhage, on the operating table.

In operating upon tumors of large size, it is well to remember anatomical considerations. Reynolds and Wadsworth[1] call attention to Gerota's[2] work on the perirenal fascia. This fascia is formed by the splitting of the fascia of the abdominal wall at the outer border of the kidney. One layer gets in behind the perirenal fat (retrorenal fascia) and is lost in the tissues behind the kidney, while the other takes a similar course in front of the kidney (prerenal fascia). The prerenal fascia crosses in front of the large vessels, and is continuous with the fascia on the opposite side. The space formed by the two layers of fascia, in which the kidney lies, is called the perirenal space. Reynolds and Wadsworth[3] were the first to point out the significance of this fascia in operating upon perirenal growths, and what follows with reference to operative technique is taken

[1] Ann. of Surg., 1906, July, p. 64.
[2] Beiträge zur Kenntniss des Befestigungs-Apparates der Niere, Arch. f. Anat. u. Entwickelungs Geschichte, 1895, pp. 265-282.
[3] Loc. cit., p. 65.

largely from their work. The fascia affords a sure, safe guide in operating upon tumors of this nature. In the case of very large tumors, such as lipomata, the growth sometimes follows the fascia to the opposite side of the body. If one identifies the fascia, which he can do with ease, he will find the line of cleavage between it and the growth underneath. The fascia will offer a landmark of extreme importance. It forms the capsule of the growth, and can be dissected up without trouble by a careful operator. It separates the tumor from important structures in front, the colon, the entire small intestine, and the pancreas. The superior and inferior mesenteric arteries are also in front of the prerenal fascia, except at their origin, when they cross the perirenal space. These vessels are, therefore, liable to injury during an operation. The same is true of the spermatic and ovarian vessels. The ureter in the upper part of its course is surrounded by the substance of the growth, while lower down it may be found between the tumor and the capsule on its inner side, or it may penetrate the growth itself. A point of importance in operating is, that the incision into the peritoneum covering the growth must, if possible, be made to the outside of the colon. If made to the inside of the gut, such an incision will cut off the blood supply of the bowel, and the corresponding portion of the bowel becomes gangrenous in consequence. If it should be impossible to make this incision on account of anatomical difficulties, that portion of the bowel which has been deprived of its blood supply must be resected. If the tumor be a large one, and if it be found impossible to remove it entire by an incision on one side, an incision on the opposite side of the body should be made. It is well to attack the growth in its outer and lower portion, in the first instance, because here the blood supply is not great, and there is little danger of hemorrhage. In attacking the growth an effort should be made to remove it piecemeal, unless it be malignant. Its lobulated character, especially in the case of lipoma, will be

of assistance here, and it will be found that it can be removed with ease. Making headway, the kidney is soon reached, and this organ can be isolated much more easily than it could be if rough dissection of the entire mass were attempted. The renal vessels and the vessels leading from the aorta and vena cava in the median part of the body, will require careful consideration, for it is in this location that the chief danger of operation will be found.

Operations for cysts are usually easy. The cyst wall can generally be removed entire on account of the usual absence of adhesions in these cases. If, however, it cannot be removed with ease, the opening into the cystic cavity may be stitched into the abdominal wound, and it may be allowed to drain.

Operations for cysts are usually easy. The cyst wall can depend upon the size of the growth, the length of time the disease has been in existence, and the presence of complicating elements. Adhesions greatly increase the operative risk. Malignant disease is the most serious, both on account of the constitutional effect on the patient, and also because adhesions in this disease are usually quite extensive . An incomplete operation is very fatal. If the kidney has to be removed this will also increase the operative risk. Hartmann and Lecène[1] in a list of twenty-seven cases of perirenal tumor, record that in eighteen it was necessary to remove the kidney, and in only nine was the kidney preserved. In seven of these twenty-seven cases death resulted. It should be said, however, that these cases covered a long period of time. Albarran and Imbert[2] in a list of forty-five cases record twenty-seven cures, twelve deaths, and five in which the result is unknown; cysts are not included in this list. During recent years the operative mortality has been greatly lessened. Since 1890, with a better selection of cases, earlier operation, and improved technique, the mor-

[1]Travaux de Chir., Paris, 1903, p. 63.
[2]Loc. cit., p. 601.

tality has dropped to six per cent.; whereas, before 1890, it was fifty-three per cent.[1] Adami[2], in a list of twenty-six operative cases for lipomata, records twelve, or forty-six per cent., in which the operation was successful.

The prognosis after operation, if the growth is of a benign character, is usually good. Recurrence, however, may be seen, even after lipomata. Waldeyer and Freund[3] and Adami[4] record cases in which a myxolipoma degenerated in parts to sarcomatous tissue. Tillman's[5] case of lipomyxofibromatosum recurred a year after operation. It was supposed, though this was doubtful, that in this case the recurrence was as sarcoma. In case of sarcoma, of course, the prognosis is very bad, and the same is true of mixed tumors.

[1] Albarran and Imbert, Les Tumeurs du Rein, Paris, 1903, p. 602.
[2] Loc. cit., p. 25.
[3] Virch. Arch., 1865, vol. 32, p. 543.
[4] Montreal Med. Jour., 1896-1897, vol. 25, p. 628.
[5] Hygiea. 1891, vol. 1, p. 277.

CHAPTER VII.

ADRENAL TUMORS IN ADULTS

ETIOLOGY

Williams[1], in a series of 8378 consecutive cases of tumor occurring in various parts of the body, found only one case of malignant tumor of the suprarenal gland. He collected thirty-six cases of adrenal tumor, and in more than one-third of them the subject was a child. In Ramsay's[2] list of thirty-seven malignant adrenal tumors are found thirty-six in the male, twenty-six in the female, and in five the sex is not given.

PATHOLOGY

Adrenal tumors are benign and malignant. Brüchanow[3] gives a list, covering a period of fifteen years, of thirty-three cases of adrenal tumor taken from Chiari's laboratory. Twenty-five of these tumors were of that form now usually described as benign hypernephroma of the adrenal, sometimes called "adenoma," occasionally "struma," and sometimes "hyperplasia."

Benign Tumors

These growths are extremely rare and are usually pathologic findings. The following have been found in the adrenal: angioma, glioma, neuroma, gangliofibromyoma, lymphangioma, lipoma, cysts, and hypernephroma.

Virchow's[4] case of glioma is the first mentioned of its kind. The tumor was the size of a cherry.

[1]London Lancet, 1897, vol. 1, p. 1261.
[2]Johns Hopkins Hospital Bulletin, 1899, vol. 10, p. 24.
[3]Zeit. f. Heilkunde, 1899, vol. 20, p. 39.
[4]Krankhafte Geschwülste, Berlin, 1864-1865, vol. 2, p. 150.

Küster[1] also described two tumors whose characteristics were abundance of round nuclei, absence of protoplasm, which was substituted by a network of fine fibrillae, and inclination of the nuclei to form rosettes; this gave the impression that the tumor was made up of collections of rosettes. The whole had a strong resemblance to gliar tissue, and Küster made the probable diagnosis of glioma.

Dagonet[2] described a tumor the size of a large white kidney, which was made up of connective tissue and smooth muscle fiber, with additional groups of ganglion cells. He called it a gangliofibromyoma.

Weichselbaum[3] described a tumor the size of a cherry, which under the microscope was found to be made up of numerous interlacing bundles of fibers, which appeared to be non-medullated nerve fibers having spindle-formed nuclei; there was also a peculiar large cell which on examination resembled a ganglion cell; these cells were arranged either singly or in groups. He considered the tumor to be a ganglioneuroma.

Brüchanow[4] describes a gangliofibroneuroma found in the left adrenal of a female sixty-eight years of age. The tumor was 1 cm. in diameter and sharply marked off from the surrounding tissue. Microscopically the tumor was composed of bundles of fibers having a wavy arrangement running in different directions and across each other. The growth consisted partly of connective tissue and partly of medullated nerve fiber. Here and there were thin nerve fibers in a hyaline sheath; there were also peculiar large cells which resembled ganglion cells. They lay sometimes singly, but for the most part in groups; some were round and some were elliptical; some were apolar and others had one, two, or more processes. All the specific elements of the nervous system were contained in this tumor.

[1]Virch. Arch., 1905, vol. 180, p. 120.
[2]Zeit. f. Heilkunde, 1885, vol. 6, p. 23.
[3]Virch. Arch., 1881, vol. 85, p. 555.
[4]Zeit. f. Heilkunde, 1899, Vol. 20, p. 39.

Brüchanow's[1] case of lipoma of the adrenal is rare. This tumor was an autopsy finding in a female sixty-seven years of age. It projected above the cortex as a sharply circumscribed disk 20 mm. in breadth. It was composed of fat tissue.

The cysts of the adrenal are of five kinds: the parasitic, the true glandular cysts, the cysts found in hypernephroma, cysts arising from lymphangioma, and the pseudocysts.

True glandular cysts are of extreme rarity, and are unimportant, as they are of small size, and give no symptoms; they occasionally take origin from embryonic remains.

The cysts sometimes found in hypernephroma are comparable to the cysts occasionally seen in "struma" of the thyroid, and in these cases are of small size, and unimportant. Henschen[2] believes, however, that these cystic dilatations in the case of hypernephroma may reach a large size.

The cysts arising from lymphangioma are the result of lymphangiectasis, and may attain to a very large size. This form is the one usually found in the adrenals. In this variety the cyst wall is thick, and sometimes contains muscular fibers; the cavity is lined with flattened endothelium. These cysts may be either unilocular or multilocular. The contents are either a dark or a light fluid of watery consistence.

The pseudocysts result from tubular softening, or they are collections of blood.

Cystic disease of the adrenal is of great rarity, and Terrier and Lecène[3] have recorded only ten instances in literature.

Benign hypernephroma will be discussed with the malignant tumors.

Malignant Tumors

As in the case of the kidney, the question of malignant tumors of the adrenal is far from settled. There exists

[1] Loc. cit., p. 44.
[2] Beitr. z. Klin. Chir., Tübingen, 1906, vol. 49, p. 226.
[3] Revue de Chirugie, Paris, 1906, vol. 26, p. 325.

great confusion with regard to these tumors, a confusion which has been made needlessly great by the desire and attempt of many writers to explain what is as yet incapable of solution. In the published reports of cases and in pathologic reports there exists no uniformity of opinion as to the nature of the growths under discussion. Cases of "carcinoma" of the adrenal are met with in literature which

Fig. 36A.—Malignant Adrenal Tumor, found at Autopsy. Size of an adult head. Weight 2757 grams. There were no metastases. From Blackburn; Amer. Jour. Med. Sci., 1906, vol. 132, p. 267, and Jour. Amer. Med. Ass., 1888, vol. 10, p. 389.

exactly resemble, with reference to the histologic structure of the tumors, other cases of "sarcoma" or "adenoma" or "malignant struma," reported by other writers of equally good repute. In the presence of such confusion, statistics bearing on the relative frequency of the variously described malignant tumors can have no value.

Hektoen[1] in his introduction to this class of tumors presents the case in a very judicious way: He says: "The nomenclature of these tumors presents certain difficulties,

[1]American Text-book of Pathology, 1901, p. 920.

because in their morphology and in the arrangement of the cells and the stroma they resemble adenomata and carcinomata and are frequently described as such. The more

Fig. 36B.—Malignant Adrenal Tumor. View of the tumor shown in Fig. 36A, showing the size of the growth relative to that of the liver, the under surface of the later also being shown. From Blackburn; Amer. Jour. Med. Sci., 1906, vol. 132, p. 267; and Jour. Amer. Med. Ass., 1888, vol. 10, p. 389.

diffuse hyperplasias of this kind were long ago designated as 'struma suprarenalis' by Virchow. In view of their peculiarities these tumors are given more general non-specific names, such as 'adrenal tumors' (*sensu strictu*) or hypernephroma."

The chief characteristics of a malignant growth of the adrenal are the following:

The tumor is either single or multiple; when multiple the growth is composed of variously sized nodules, each surrounded by a capsule which limits it from the surrounding adrenal tissue. The large tumors may reach a good size, even that of one or two fists or much larger. Metastasis is mainly through the circulatory system; the organs chiefly attacked are the lungs, liver, and bones. It is to be remarked that the organs attacked secondarily are those chiefly attacked by hypernephroma of the kidney. The

metastases resemble the parent tumor and bear a striking resemblance to a hypernephroma of the kidney (Fig. 37). These peculiarities are strong proof that the Grawitz tumor in the renal parenchyma is derived from adrenal "rests" in the kidney.

Under the microscope malignant tumor of the adrenal resembles markedly the cortex of the normal adrenal body,

Fig. 36C.—Malignant Tumor of the Adrenal. Tumor of the right adrenal gland, sectioned in the middle to show its structure and shown in relation to the kidney which it nearly equals in size. The section shows the appearance of the tumor tissue, the interior broken down by degeneration, and the more solid tumor tissue mottled by hemorrhage and pigmentation. The capsule is seen to be very distinct but no septa enter the tumor, the appearance of such being the looser, more degenerated portions of the tumor between the more actively growing centers. The kidney shows a slightly granular surface, indicating some interstitial change, but no secondary tumor growths are seen on the surface shown. From Blackburn; Amer. Jour. Med. Sci., 1906, vol. 132. p. 270. Microscopic sections of this tumor are shown in Figs. 37, 37A, 37B, 38.

both in the form and arrangement of the cells (Fig. 38). In some places the arrangement suggests that of the zona reticularis, in others that of the zona fasciculata. Thin walled capillaries surround the groups of cells, which are arranged in columns or rows two or three deep in alveolar form, and connective tissue septa from the capsule of the tumor penetrate the growth and divide it into separate

parts. The cells, in rows, are placed directly on the capillary vessels, as in hypernephroma of the kidney; the first row is placed tolerably perpendicularly on the walls, and the

Fig. 37.—Malignant Tumor of the Adrenal, showing arrangement of the cells in a metastatic deposit in the lungs. Note the arrangement in trabeculae, suggesting the zona fasciculata, and zona reticularis of the adrenal gland.,This tumor is shown in the gross in Fig. 36c. From Blackburn; Amer. Jour. Med. Sci., 1906, vol. 132, p. 272.

others rather irregularly; they have large nuclei, are polygonal in shape, and contain vacuoles which correspond to areas which formerly contained fat which has been extricated in the process of mounting. The shape of the capillary interspaces between the tumor cells is often quite irregular. Evidences of hemorrhage and necrosis are seen in places.

Benign forms of adrenal tumor (other than those previously described) *resemble the malignant tumor to a marked degree.* They may remain latent in the adrenal for a long time and may give no evidence of their presence. Most of the benign growths do not exceed the size of a pea or walnut. They may be single or multiple.

Under the microscope the benign growths also show pictures recalling to a marked degree the adrenal cortex in shape and arrangement of the cells (Figs. 39, 40 and 41). So

Fig. 37A.—Malignant Tumor of the Adrenal. Field drawn from a secondary nodule in the lung, showing enlarged cells with degenerated nuclei. The great irregularity in size and form of the tumor cells, their shapes influenced by mutual pressure, the delicate intercellular substance and some enlarged and vacuolated nuclei are shown; and a blood vessel with eosin-stained erythrocytes, lymphocytes and polymorphonuclear cells filling the lumen and flattened endothelium and a few strands of delicate connective tissue forming the wall. Leitz, 1-12, ocular No. 3 (reduced). This tumor is shown in the gross in Fig. 36C. From Blackburn Amer. Jour. Med. Sci., 1906, vol. 132, p. 273.

closely do these tumors resemble the cortex that the term "hyperplasia of the adrenal" has frequently been given to the growth. As in the malignant tumor, the groups of cells are arranged in columns or rows in alveolar form, and the cells rest on thin-walled capillaries which form part of the stroma of the tumor. The cells are polygonal, have large nuclei, but they are smaller than is the case in the malignant growths, and another marked difference is that in the benign form the rows of cells are arranged much more regularly, and the capillary interspaces are narrower.

The similarity in structure between the apparently benign forms of adrenal tumor and the malignant suggests a close relation between the two. There are many who assert

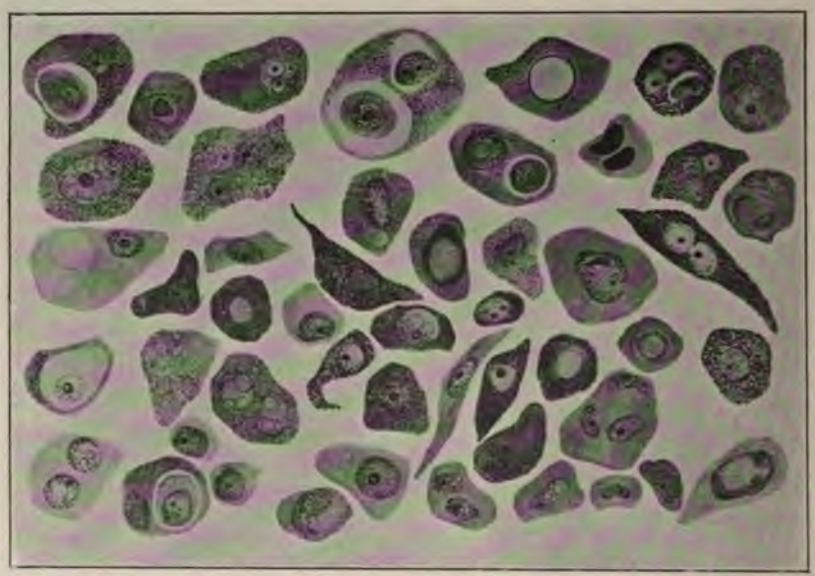


Fig. 37, B.—Malignant Tumor of the Adrenal. A number of cells from various fields of secondary nodules in the lungs. Almost all the types of normal and degenerated tumor cells are here represented. Vacuolation of the cells and their nuclei is shown, cells of bizarre forms and a number of so-called "cell-inclusions," known to the older pathologists as endogenous cells or "daughter cells." Almost every phase of nuclear degeneration is represented. Leitz, 1-12, ocular, No. 3 (reduced). This tumor is shown in the gross in Fig. 36C. (From Blackburn; Amer. Jour. Med. Sci., 1906, vol. 132, p. 274.)

that the benign go on into the malignant. This has its analogy in hypernephroma of the kidney and in other kinds of tumors in other parts of the body.

A study of the histologic characters of the tumors of the adrenal, benign and malignant (other than those described at the beginning of this chapter) given in the literature of the subject discloses the fact that they all closely resemble one or the other of the two forms just described. These tumors have been variously named. The benign forms have been called "struma of the adrenal," "hyperplasia of the adrenal," "benign adenoma of the adrenal," etc., while to

the malignant forms have been given the following names "carcinoma," "malignant struma," "sarcoma," etc.

All the tumors designated "sarcoma," found in litera-

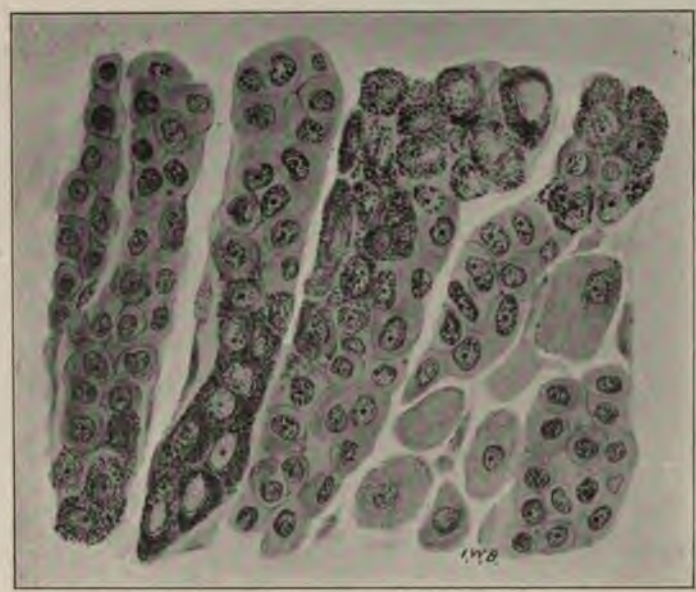


Fig. 38.—Malignant Tumor of the adrenal, showing several Trabeculae of cells, from two to four cells thick, extending in parallel rows, strongly resembling the normal gland. Capillary blood vessels in between the rows of cells. This tumor is shown in the gross in Fig. 36C. (From Blackburn; Amer. Jour Med. Sci., 1906, vol. 132, n. s., p. 275.)

ture, reveal practically the same features, namely: arrangement of the cells in columns or rows in a manner suggesting the zona fasciculata of the normal adrenal; capillaries surrounding the groups of cells arranged in alveolar form. The same is true of the tumors designated "adenomata," and "carcinomata." It is thus evident that there is a great deal of confusion in regard to these growths. In a very few rare cases, such as that described by Blackburn[1], the presence of melanotic granules in the cells would seem to point to a sarcoma rather than to a carcinoma or an adenoma (Fig. 38). These cases, however, are of the rarest

[1]Am. Jour. Med. Sci., 1906, vol. 132, n.s., p. 266.

occurrence and only two or three are reported in literature.

Blackburn himself in commenting on the probable nature of his growth says: "The lack of uniformity in size and shape of the cells, the presence of an indefinite but de-

Fig. 39.—Benign Hypernephroma of the Adrenal, showing the Tumor, the Capsule, and a small portion of the zona fasciculata (X62). It is to be noticed that the tumor bears a marked resemblance to the zona fasciculata. Classified as "Benign Adrenal Adenoma" at Lab'y at Boston City Hospital. No. 98.55.

monstrable intercellular substance, and the mode of invasion of the tumor in the vicinity of the growth, aside from other histological details, seem to be diagnostic of sarcoma; if it be decided that all growths arising from adrenal epithelium, irrespective of histologic details, should be designated hypernephroma, and at the same time the capability of adrenal cells to form a sarcoma tumor be denied, the growth in question may be called hypernephroma." Blackburn is thus rather in doubt about the proper classification of this growth, but in concluding his article he is inclined

to class it with the "general class of sarcomata, however modified."

Various views are held by different observers in regard

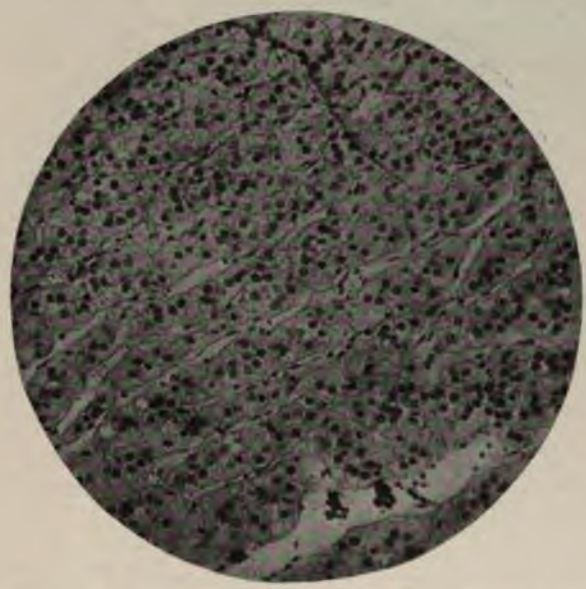


Fig. 40.—Benign Hypernephroma of the Adrenal, showing the arrangement of cells, two or three rows deep, in close apposition to the thin-walled capillaries, which form the stroma of the tumor (X125). Classified as "Benign Adrenal Adenoma" at the Lab'y at the Boston City Hospital. No. 98.55.

to the nature of adrenal tumors.

Ribbert[1] calls these tumors adenomata, and states that there is a benign and malignant form, with transition forms in between. He calls attention to the fact that the structure of both benign and malignant forms is essentially the same[2], but he denies the existence of definite alveoli marked off by septa, and describes the appearances as "columar cell masses arranged in the network of blood vessels." Within some of the masses was a lumen due to central necrosis and not to be considered true glandular formation. He thinks that the diagnosis of these adrenal "ade-

[1]Geschwülstlehre, Bonn, 1904, p. 420.
[2]Loc. cit., p. 430.

nomata'' can be easily made from the character of the structure of the youngest portions of the growth.

Letulle[1] has given to these growths the name ''nodular

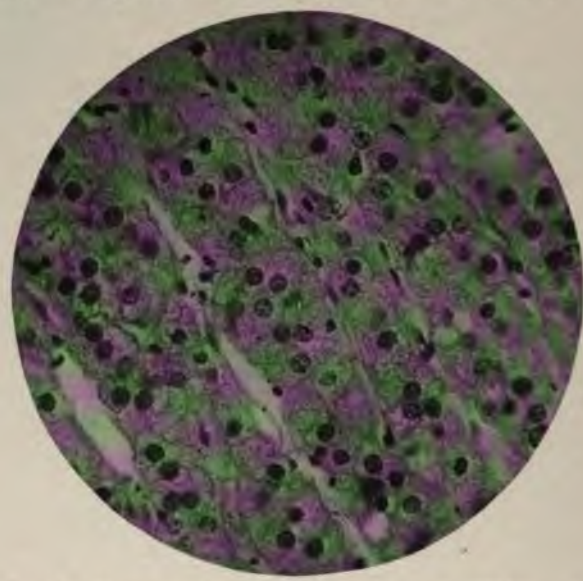


Fig. 41.—Benign Hypernephroma of the Adrenal (X250), showing the arrangement of the cells, two or three rows deep, in close apposition to the thin-walled capillaries, which form the stroma of the tumor. Classified as "Benign Adrenal Adenoma" at the Lab'y at the Boston City Hospital. No. 98.55.

hyperplasia'' of the suprarenal capsule. He considers the growth in the beginning to be a simple hyperplasia of the middle zone of the cortical substance, and more rarely a hyperplasia of the glomerular zone. He thinks that by insensible transitions large nodules of hyperplasia may pass to ''adenomatous'' or ''benign epitheliomatous'' forms, and he believes that he has been able to detect hyperplasia as well as adenomatous formation in the same specimen.

Virchow[2] was the first to call attention to this form of growth, and he gave it the name ''struma suprarenalis.'' He compared it to thyroid hyperplasia, and called attention to the marked similarity which exists between the two tumors.

[1]Soc. Anat., Paris, 1892, 5th series, vol. 6, p. 334.
[2]Krankhafte Geschwülste, 1864-1865, vol. 3, p. 90.

"A characteristic of the growth is the condition of hyperplasia of the fascicular portion of the adrenal."

Borst[1] speaks of a diffuse swelling which corresponds to a general hypertrophy or hyperplasia; and also of circumscribed larger and smaller tumors occurring as soft, yellowish enlargements in the cortical or medullary substance of the organ, which consist of typical suprarenal structure. In both of these forms, according to Borst, there is a delicate stroma formed almost entirely of capillaries which embrace larger masses, either in the form of pillars, or at times in the shape of larger polygonal roundish masses of cells situated around the capillaries. Borst thinks that from this suprarenal hyperplasia there are real or apparent transitions into tumors of considerable size, which show variation from the structure of the normal suprarenal, in that the single masses of cells not only increase in number, but also that the single cells are larger. Borst is not willing to separate this form from the group of hyperplastic tumors, and he furthermore states that he does not believe that it is a glandular growth of the character of an adenoma. Until the obscurity which surrounds it has been cleared up, he thinks that a purely indefinite name should be given to it, and that the term hypernephroma is the best under the circumstances.

It will be seen from the foregoing that there is a great deal of confusion in regard to these tumors. The numerous names given to the malignant form show how uncertain is its pathogenesis. It has been called "carcinoma," "sarcoma," "malignant adenoma," "perithelioma," and "adenocarcinoma," by different pathologists whose ability is unquestioned. The adrenal is histogenetically derived from the mesoderm[2] according to the latest views. This would class these tumors among those of a connective tissue type. If we adopt the histogenetic classification of tumors, it may

[1] Die Lehre von den Geschwülsten, Wiesbaden, 1902, p. 785.
[2] See Hertwig-Poll: Handbuch der Vergl. und Exper. Entwickelungslehre der Wirbeltiere, Jena, 1906, p. 443.

be right to consider the malignant form of growth a sarcoma, and many consider this to be the case. Morphologically the tumor has marked resemblance to carcinoma or adenoma, and many insist that the tumor should be classed accordingly. Until the obscurity which surrounds these growths has been cleared up, it will be well to give them the purely indifferent names, benign or malignant hypernephroma of the adrenal.

SYMPTOMATOLOGY

Benigh forms of growths give rise to no symptoms whatever, and those tumors are mere pathologic findings.

Malignant forms of adrenal growth all present the same clinical picture.

The chief characteristic of the disease is a gradually progressing condition of bodily wasting. The patient without any special assignable reason appears to be running down, loses flesh and strength, becomes anemic, is indifferent, loses ambition to work, and gets into a steadily increasing condition of decline. Anorexia is a prominent symptom, and nausea and vomiting may occur. There may be constipation or diarrhea. Sometimes there is slight fever, but usually the temperature is normal or subnormal. Later in the course of the disease edema may be present, and when it occurs it is usually due to some renal change.

The presence of tumor is a marked symptom, and directs attention to the seat of trouble. In the early part of the disease, however, repeated examinations may fail to discover any tumor at all; and this is because the adrenal is situated high up under the ribs, and cannot be reached in case of a moderate enlargement; later in the course of the disease, however, a tumor appears below the ribs. After the tumor has gotten well under way pain may assume importance. The pain is felt at the seat of the growth, but it may, however, be referred to various parts of the body, for instance,

the epigastrium, the knee, the ankle joint, and the shoulder tip.

Hematuria is of extremely rare occurrence, and usually is not dependent upon any disease of the renal substance. When it does occur it may be due to the involvement of the renal vein by the growth, thus giving rise to a condition of passive congestion of the kidney. Ramsay[1] noted it only twice in sixty-seven cases.

The skin changes are sometimes characteristic, but they are not of frequent occurrence. The color of the skin does not always show the typical bronzing which is seen in cases of tubercular disease of the adrenal, but it may assume a peculiar dirty, brownish color. Ramsay[2] found definite bronzing, however, in three out of thirty-seven cases; in nine of these cases there was some change in color, such as slight brownish discoloration; in others the skin was simply muddy looking. The parts of the skin affected by the discoloration are the face, hands, genitals, axillae, gums, and nipples. The reason why Addison's disease produces more characteristic skin changes than are seen in malignant trouble may be explained in part by the very destructive nature of the tubercular process, by which the cells are completely destroyed. In malignant disease the case is different. In the first place, the tumors are often unilateral, and in the second place, the cells of the new growth do not interfere seriously with the function of the organ. This is a feature of malignant disease, and finds its proof in cases of carcinoma of the liver, the metastases of which sometimes secrete bile.

In some cases of malignant disease of the adrenal the symptoms are not referred to this organ. Ramsay calls attention to this fact, and found this to be the case in thirteen out of his sixty-seven cases. In five of these the symptoms were confined entirely to the respiratory tract; among the

[1]Johns Hopkins Hosp. Bul., 1899, vol. 10, p. 25.
[2]Loc. cit., p. 25.

remaining eight, one patient died of sudden edema of the glottis, while the other died from natural decline without any recognizable symptoms whatever.

Toward the end of the disease emaciation is extreme; there is a condition of profound cachexia, and the end may be by convulsion or coma. Uncontrollable diarrhea has sometimes contributed to a fatal termination.

Symptoms due to cysts of the adrenal are obscure and ill-defined. It is almost impossible to distinguish them from pararenal cysts, and the two affections are clinically practically identical. Suggestive of adrenal cyst is a tumor of slow evolution developing in the hypochondriac region, with a tendency to press the diaphragm upward, and pointing below the costal margin. Occasionally these cysts will give rise to excessive pain, coming on in attacks like gastric crises; these pains sometimes radiate toward the sacrum and the thoracic region, and may be accompanied by vomiting. Owing to the non-malignant character of the affection one would not expect to see such marked symptoms of progressive wasting and decline as are seen in the case of malignant disease of the adrenal. Urinary symptoms are usually absent.

DIAGNOSIS

The diagnosis of adrenal growth is extremely difficult. The gradual loss of weight, anorexia, physical decline, and wasting are suggestive, but not characteristic. These symptoms are indicative of a serious disease. A gradually growing tumor in the hypochondriac region, pushing the diaphragm upward, and pointing below the costal margin, has the characteristics of an adrenal tumor; but here it is difficult to distinguish such a tumor from a renal growth. Finding an area of tympany across such a growth is also of importance, because naturally from the retroperitoneal position of the tumor the intestine will always be found in front of it. In the absence of tumor the metastases in

other parts of the body, to which the primary growth has given origin, should excite the suspicion that the primary focus is elsewhere, and lead to a continued examination of the abdominal contents. As hematuria is only a very exceptional symptom, Ramsay[1] having noted it only twice in sixty-seven cases, its absence, in the presence of a tumor, is of extreme diagnostic importance in differentiating renal growths, for, with the latter, hematuria is quite a constant feature. One should always remember, however, that hematuria may arise from other causes than renal or adrenal disease. The ideal finding is pain, symptoms of wasting and decline, and the presence of an unusually mobile tumor under the ribs, which is nodular in character, and at the lower end of which the smooth lower pole of the kidney may be felt; but this association is seldom met with. Adrenal tumors cannot be differentiated from pararenal tumors lying medially in front of the kidney. The urinary findings in adrenal tumor are not characteristic, and in most cases are unimportant. Pigmentation of the body is strongly suggestive, but it is rarely seen. Israel[2] calls attention to the fact that pain and paresthesia arising from the encroachment of the tumor on the nerve roots distributed along the course of the lumbar plexus is important in the diagnosis of adrenal tumor, because as a rule these are early symptoms in the case of the adrenal, and late symptoms in the case of the renal growths; the fibrous capsule of the kidney acts as a barrier, and prevents the spread of the tumor beyond the boundary of the kidney for a long time. In the case of the adrenal, however, it is different; there is no membranous capsule, and spreading to surrounding tissues is easy, hence, the early pain due to involvement of nerves. Again Israel[3] believes that renal tumors which have not developed in movable kidneys appear under the costal margin between the ninth and the eleventh ribs, while tumors of the adrenal

[1]Loc. cit., p. 25.
[2]Dtsch. Med. Woch., 1905, vol. 31, p. 1746.
[3]Loc. cit., p. 1748.

appear more toward the median line, and extend forward to the eighth or even the seventh costal cartilage; this results from the anatomical position of the gland. Tumors formed by the blending of the adrenal and kidney present the lower border as a continuous line of considerable breadth, and the boundary may be even almost horizontal.

Addison's disease rarely gives rise to a palpable tumor, and in this disease we may have tuberculosis elsewhere in the body, which is extremely suggestive of the diagnosis. The skin changes in Addison's disease are more pronounced and are more frequently met with than in adrenal growths. At the same time, Addison's disease, with masked tuberculosis elsewhere in the body, may be very difficult to differentiate.

Hepatic tumors give rise to confusion, but careful attention and observation will sometimes clear up the diagnosis. Jaundice is especially significant, but when absent, other characteristics must be relied upon. The nodular character of the edge of the liver, the increase in the size of the organ as a whole, and the association of malignant disease of the breast or of the stomach are diagnostic points in favor of hepatic cancer.

Cysts of the adrenal are extremely rare, and they are almost impossible of diagnosis. They are always unilateral and are never the cause of bronzing of the skin. Fluctuation may be felt, but this is not a distinguishing feature of tumors in this situation for a perirenal lipoma will also give the same sign. Other cysts found in this situation are hydatid cysts, pancreatic cysts, and cystic dilatation of the gall bladder. Pancreatic cysts are tense, have an elastic feel, and their relation to the stomach, being behind the organ, serves as a differentiating feature. Cystic disease of the gall bladder may be associated with biliary colic and jaundice from obstruction; the superficial position of the bladder is of diagnostic help. If seen early the adrenal cyst will be found presenting below the costal margin, and more

to the right and more posteriorly than the gall bladder; there will probably be resonance in front of it. Cysts of the mesentery, mescolon, serous cysts of the spleen, and finally hydronephrosis, may be mistaken for this disease.

TREATMENT

The first question which comes up in regard to treatment is the condition of the opposite kidney. Here there is a real danger in the case of adrenal tumor if the disease has been progressing slowly. If it is confined principally to the adrenal gland, and the corresponding kidney has either not been seriously encroached upon or not at all, it will necessarily result that this kidney will continue under these circumstances to perform its functions in a normal or nearly normal way. The opposite kidney will not, therefore, have undergone compensatory hypertrophy which it would otherwise have undergone *pari passu* had the renal parenchyma of the diseased side been destroyed; both kidneys will therefore perform an equal or nearly equal amount of work. This constitutes a danger in operations for adrenal tumor. If the kidney on the diseased side is removed with the adrenal tumor the whole work of excretion suddenly falls on the one remaining kidney, which is not as ready to resume added work as if it had undergone preliminary hypertrophy. Anuria, therefore, is greatly to be feared, and it is this danger which makes operations so serious. Morris[1] would not agree with Ramsay in always removing the kidney with the tumor. He advises partial nephrectomy in case of need, and if the kidney appears to be sound he believes it should not be touched.

There is a decided tendency toward involvement of the opposite adrenal and its condition should be investigated by palpation through an abdominal incision before the radical operation begins.

The operation for removal of adrenal growths is very

[1]Brit. Med. Jour., 1899, p. 1341.

serious. Adhesions to the liver and spleen give rise to considerable danger of hemorrhage, and diaphragmatic adhesions may lead to accidental opening of the pleural cavity or pericardium.

As the operation offers the only chance for relief it should always be advised, especially in cases in which the growth is causing severe pain. Left to itself the disease terminates in death in about ten months.

In the few cases of adrenal tumor of the malignant type, in which operation was performed, to the number of four, death followed either immediately or within a few weeks. Ramsay[1] reports a survival, after three years, in a female fifty-three years of age; but a careful perusal of the histologic character of this tumor shows that there was an entire absence of structure ordinarily found in malignant adrenal tumors, and there were no metastases. The main part of the tumor was a large cyst. The few cases mentioned are: two reported by Ramsay[2]; Robert's[3] case; and Thornton's[4] case.

Cysts of the adrenal should be removed if possible. The course to be followed must depend on the extent and the firmness of the adhesions; if the cyst wall can be separated from the surrounding structures with ease and within a reasonable time, it is advisable to adopt this course; otherwise it would be better, after emptying the contents of the cyst, to suture the opening to the abdominal incision.

[1]Loc. cit., p. 22.
[2]Loc. cit., pp. 23, 24.
[3]Inter. Clinics, Ser. III, vol. 1, p. 203.
[4]Surgery of the Kidneys: Harveian Lectures, 1889, London, 1890

CHAPTER VIII.

ADRENAL TUMORS IN CHILDREN

The disease varies somewhat from that in the adult, and it seems best to describe it as an entity.

The age at which the disease shows itself may be seen by a glance at the following table, which was compiled from twenty-five cases.

6 months or under	5
6 months to 1 year	1
1 year to 18 months	4
18 months to 2 years	3
3 years	3
4 years	3
5 years	1
7 years	2
11 years	1
12 years	1
14 years	1
	25

There is a large preponderance for the female sex in adrenal tumors in children, no less than fifteen in the writer's table being females, while there are but six males mentioned. In four the sex is not stated.

There is likewise a decided preponderance for the left side; in thirteen the left side was affected; in seven, the right side; in one the disease was bilateral; and in four the side was not stated.

PATHOLOGY

Many of the tumors found in children exactly correspond to those found in adults. In these cases the structure is that of a hypernephroma, both the benign and the malignant forms being represented.

Besides the adrenal tumors in children belonging to the hypernephroma class a number of others have been reported as being true sarcomata. Owing to the confused state of the pathology of these tumors it is impossible to judge from the published reports whether or not the tumors described were true sarcomata. It is undoubtedly the case that many of them were not. In a number of instances tumors described as sarcomata have been called so by observers who have not sufficiently studied the pathology. Quite recently a number of tumors occurring in childhood have been reported as sarcomata, which appear to have all the characteristics of embryonic tumors. The type of cell is unquestionably embryonic. It is not correct to assign to the sarcoma class all tumors in which the cell is a small round cell, even if it has associated with it a delicate reticular framework. A peculiarity of this growth is that it is apt to take on a rosette shape in the arrangement of the cells. Many of these tumors are blastoneuromata. Just how frequently they occur it is impossible to say for the reason that reports of cases are incomplete and inaccurate in many instances. It is not correct to classify these growths with the lymphocytomata, as has recently been proposed, for they do not belong to this type.

As for definitely classifying the adrenal growths in children from the pathologic reports of published cases, this is quite impossible; there is too much confusion in nomenclature and in description. The classification of these growths must be left to the future.

The growths may be very small and yet may give rise to metastases which are the cause of death. Reiman's[1] case illustrated this very well. There was a small tumor in either adrenal. On the right side the growth was about four centimeters in diameter, while that on the left was only two centimeters. The microscopic picture showed clearly the malignant type. The patient had not exhibited

[1]Prager Med. Woch., 1902, vol. 27, p. 297.

any special symptoms on the part of the adrenals, but the metastases from these growths were remarkable. The disease was first manifested by a small nodule which was found on the abdomen. Metastases were also found after death in the liver, thorax, muscles, various bones, axillae, ears, temporal bones, and mammary glands.

On the other hand, quite large growths may give rise to no metastases whatever.

Hutchinson[1] has recently called attention to the fact that adrenal tumors in children are very apt to give rise to metastases in the temporal bone.

Metastases in general in all adrenal growths in children are not infrequent. They occurred 12 times in 25 cases. The seat was as follows:

Retroperitoneal glands	4
Mediastinal glands	1
Liver	9
Ovary	2
Pancreas	1
Lungs	4
Temporal bone	5
Ribs	1
Spinal column	1
Vena cava	1
Axillary glands	2
Skin	1
Mammary glands	1
Muscles	1

SYMPTOMS

The disease in children is, in the main, very similar to that in the adult. There is the same bodily wasting and the same mental apathy, which in the child takes the form of stupidity and evident backwardness. This may be a marked feature before local symptoms have manifested themselves. The child is noticeably dull and does not develop in the normal way; the speech may be thick, and the

[1] Quart. Jour. Med., Oxford, 1907, vol. 1, p. 33.

child does not talk plainly. Anemia comes on early and is a marked symptom as the disease progresses. Towards the end of the disease the symptoms due to a rapidly growing tumor become prominent.

The onset is sometimes quite sudden, and is occasionally shown by peculiar disturbances in the growth of the body. The child may become suddenly stout without apparent reason, and there may be great muscular development. The disease is occasionally manifested by symptoms referable to metastases, and chief among these are the metastases in the temporal region. If the metastasis takes place in the region of the orbit, there may be disturbances within the skull which may lead to intracranial pressure, intense optic neuritis, and blindness, and the patient may die in coma. These cases have happened with sufficient frequency to lead Hutchinson to regard them as a special class, and he particularly directs attention to the fact that in the presence of a tumor of the orbit the adrenal region should be examined with the greatest care.

By far the most interesting feature of the disease in children are the changes that are produced in the body with reference to growth and development. Chief among these is precocious puberty. In the writer's list of cases it occurred no less than ten times in tewnty-five cases. This precocity is shown by the general appearance of the patient. A child of fourteen may look like a little man of forty years of age; there may be a thick growth of hair on the face, as well as in other parts of the body, especially in the genital regions and in the axillae. Besides these changes there is also marked premature development of the genital organs and they occasionally develop in an abnormal way. Orth[1] reports the case of a female child four and a half years of age, who had pubic hair during the last six months of life. The external genitals were precociously developed and the

[1]Arbeiten aus dem Path. Institute zu Göttingen, Berlin, 1903, p. 75, vol. 56, p. 157.

clitoris was like a small penis. The breasts may also be overdeveloped. Ritchie[1] reports a most curious case, that of a female four years old, whose genitals were thought to be hermaphroditic, but they were not—they were simply hypertrophied. Besides these changes there may also be overproduction of fat tissue. Hutchinson[2] has recorded an extraordinary case of asymmetrical hypertrophy of the body in a male child four months old, affected with a left adrenal "hypertrophy." The child's left side was much larger than the right, especially the thigh, leg, and arm. At the autopsy a similar condition was found in the paired organs of the body, the left sided ones being much larger than the right sided. This was particularly the case with the kidney and testicle. This peculiarity of precocious puberty is not at all confined to the malignant forms of growth, but likewise the apparently benign forms as well. This was exemplified by Ritchie's[3] case in which there was abnormal development of the genital organs. In this case there was an apparently benign growth in the adrenal.

Linser[4] believed these cases of giantism to be due to the fact that the tumor cells in enormous numbers had not entirely lost the function of the normal adrenal cells, which, in early life at least, are supposed to exert some influence on the bodily growth[5]. The latest views are to the effect that in early life while the child is growing, the adrenal has some influence on the growth of the genital organs. Linser's view seems not unreasonable, at it has been shown that the opposite condition, atrophy of the adrenals, is sometimes associated with dwarfism.

Pain is seldom complained of in adrenal tumor in children, and hematuria has not been reported.

[1]Quoted by Bullock and Sequeira: Tr. Path. Soc., London, 1905, vol. 56, p. 157.
[2]Brit. Jour. of Child. Dis., 1904, vol. 1, p. 258.
[3]Quoted by Bullock and Sequeira: Tr. Path. Soc., Lond., 1905, vol. 56, p. 197.
[4]Beitr. z. klin. Chir., 1903, vol. 37, p. 296.,
[5]See Rolleston: Lancet, London, 1907, vol. 2, p. 875.

The most important and characteristic sign of the disease is the tumor, which, if the disease has lasted long enough, is sure to make its appearance. In eighteen of the cases mentioned, tumor was present; in six, the tumor was so small as not to be appreciable, and in one, there was no statement made as to tumor. When the tumor has appeared the disease is, as a rule, well under way and comes to an end within a few months. However, exceptionally, tumor may be present for a year and a half, or even two or three years, but these are rare cases.

Skin changes are very rare. Bronzing has not been reported, but a peculiar coppery color has been recorded in a few instances.

Pressure symptoms are occasionally observed. Among these may be mentioned dyspnea, edema, and disturbances with the bowels. Towards the end of the disease cyanosis may appear.

The disease rarely lasts more than a few months, but exceptionally it may be prolonged to two or even three years. In the latter cases we must suppose that the disease has begun as a benign growth, which has later taken on malignant characteristics. As in the affection of the adult, the child gets progressively ewaker and weaker, anemia becomes more pronounced, cachexia makes its appearance, and the child gradually dies, with symptoms of marasmus. These children are peculiarly prone to intercurrent affections, and not infrequently death is due to pleuro-pneumonia.

DIAGNOSIS

The diagnosis is extremely difficult to make. Among the diseases in children which will have to be differentiated, are, malignant disease of the liver and spleen, leucocythemia, hypertrophic cirrhosis of the liver, and the various hematuriae. A careful study of the case will frequently clear up obscurities.

TREATMENT

Operation for the disease in children and infants is most fatal. Extirpation and nephrectomy has been once performed, by Dobbertin[1] on a female one year and two months old, but the child died immediately. Exploratory incision has been twice done for tumors of considerable size, by Bruck[2] and by Linser[3] respectively. In both instances death followed immediately.

[1] Zeigler, Beitr., 1900, vol. 28, p. 42.
[2] Jahrb. f. Kind., Berlin, 1905, vol. 62, p. 84.
[3] Beitr. klin. Chir., 1903, vol. 37, p. 286.

TABLE OF ADRENAL TUMORS IN CHILDREN

No.	Name and Reference	Sex	Age	Duration of Disease	Side	Tumor and Duration	Pain	Hematuria	Special Symptoms	Operation	Metastases	Pathologic Condition
1	Adams: Tr. Path. Soc., Lond., 1905, vol. 56, p. 208	Male	14 yrs. 9 mos.	3 yrs. 2 mos.	Left	3 yrs. 2 mos.	Not stated	None	Puberty at ten years. Great muscular strength. Plethoric. Dusky complexion. Growth of hair on the face. Looked like a sturdy little man			Tumor weighed 8½ lbs. Was adherent to left kidney. Called by the writer "malignant hypernephroma"
2	Amberg: Arch. Pediat., 1904, vol. 21, p. 582	Female	2 mos.	Not stated	Right	Not stated	Not stated	Not stated	Fairly well nourished		Not stated	A large tumor
3	Bevern-Römhild: (Quoted from Linser) Beitr. klin. Chir., 1903, vol. 37, p 299	Female	3 yrs.	Not stated	Left	Yes	Not stated	Not stated	Had marked growth of hair on the upper lip and trunk; also great development of fat tissue	None	Not stated	Large tumor
4	Brüchanow: Zeit. f. Heil., 1899, vol. 20, p. 54	Not stated	1 yr. 2 mos.	Not stated	Right	Yes	Not stated	Not stated		None	Retroperitoneal and mediastinal glands, liver and right ovary	Tumor the size of a fist. Structure that of malignant adrenal tumor
5	Bruck: Jahrb. f. Kinderh., Berl., 1905, vol. 62, p. 84	Female	1 yr. 2 mos	2 weeks (apparent)	Right	2 weeks	Not stated	Not stated		Exploratory incision. Died at once	Liver, pancreas, and mesentery glands	"Round cell sarcoma"
6	Bulloch and Sequeira: Tr. Path. Soc., Lond., 1905, vol. 56, p. 190	Female	11 yrs.	1 yr. 3 mos.	Left	Yes	Not stated	Not stated	Thin and pale until fifteen months before, and then became very fat. The appearance of a woman forty years old. Skin coarse. On chin and lips abundant hair. Breasts large. Pubic region and axillae covered with long hair. Cyanosis		Liver, lungs	Tumor weighed 3 lbs. Histologic structure that of malignant adrenal tumor. The writers called the growth "a malignant hypernephroma"

TABLE OF ADRENAL TUMORS IN CHILDREN (Continued)

No.	Name and Reference	Sex	Age	Duration of Disease	Side	Tumor and Duration	Pain	Hematuria	Special Symptoms	Operation	Metastases	Pathologic Condition
7	Cohn: Berl. klin. Woch., 1894, vol. 31, p. 266	Female	9 mos.	6 weeks	Left	6 weeks	Not stated	Not stated	Exophthalmos	None	Right temple bone, liver, ovary, mesenteric glands and ribs	Tumor called "medullary sarcoma"
8	Colcott and Fox: Tr. Path. Soc., Lond., 1895, vol. 36, p. 460	Female	2 yrs.	1 yr. 2 mos.	Left	1 yr. 2 mos.	Not stated	Not stated	Rickety, gross, bloated, with dusky pallor, but no pigmentation. Surface of body hairy about the genital regions. Clitoris, vulva and labia much developed. Appetite ravenous. Intellect dull.	None	Lungs	Tumor weighed 1½ lbs. Presented structure of malignant tumor
9	Cook: (Quoted by Linser) Beitr. klin. Chir., 1903, vol. 37, p. 299	Female	7 yrs.	Not stated	Right	Yes	Not stated	Not stated	Enormous development of fat. Abundant growth of hair on face. Great bodily strength. Died in convulsion	None	Not stated	Large tumor of the right adrenal
10	de Ruyter: Arch. f. klin. Chir., 1890, vol. 40, p. 98	Not stated	10 days	Since birth	Left	10 days	Not stated	Not stated		None		Type of malignant adrenal tumor
11	Dobbertin: Zeigler. Beitr., 1900, vol. 28, p. 42	Female	1 yr. 2 mos.	1 yr. 2 mos.	Not stated	1 yr. 2 mos.	Not stated	Not stated	Thick, long hair on both labia majoria, lower abdomen, and thorax	Nephrect.	Not stated	Large tumor
12	Earle and Weaver: Jour. Am. Med. Ass., 1894, vol. 23, p. 980	Male	2 yrs.	3 mos.	Right	3 mos.	Not stated	Not stated	Jaundice, dyspnea, epistaxis, edema	None		Cirrhosis of the liver. Small tumor in right adrenal, apparently benign in structure

TABLE OF ADRENAL TUMORS IN CHILDREN (Continued)

No.	Name and Reference	Sex	Age	Duration of Disease	Side	Tumor and Duration	Pain	Hematuria	Special Symptoms	Operation	Metastases	Pathologic Condition
13	Greenhow: Tr. Path. Soc., Lond., 1867, vol. 18, p. 260	Female	12 yrs.	Not stated	Not stated	None	Not stated	Not stated	Died of pleuro-pneumonia	None	None	Small tumor 3 in. long. Character uncertain
14	Hutchinson: Quart. Jour. Med., Oxford, 1907, vol. 1, p. 37	Male	3 yrs.	"Anemic a long time"	Not stated	None felt	None in adrenal region	Not stated	Hemorrhage from gums, anemic, proptosis of the left eye. Blindness. Optic neuritis	None	Left temporal bone, Spinal column	"Sarcoma medullary part of adrenal." Malignant type
15	Hutchinson: Brit. Jour. Chil. Dis., 1904, vol. 1, p. 258	Male	4 mos.	4 mos.	Left	None felt	Not stated	Not stated	Asymmetry of body. Left side hypertrophic, especially leg. Died of bronchial pneumonia	None	None	Viscera healthy, except left adrenal. Paired organs asymmetrical; left kidney 50 grams, right kidney 38 grams; left adrenal 42 grams, right adrenal 14 grams; left testicle 2.3 grams, right testicle .55 grams. "Hypertrophy of the left adrenal." (Hutchinson thought the condition to be due to unequal segmentation in the ovum in embryonic life.)
16	Linser: Beitr. klin. Chir., 1903, vol. 37, p. 286	Male	5 yrs. 6 mos.	10 mos.	Left	Yes	Yes, severe	Not stated	Developed normally until ten months previous; then growth of hair on the body in abnormal places. Mental defect. Could not talk plainly. Rickety rosary. Thyroid small	Exploratory incision. Immediate death	Vena cava, lymphatic glands, and lungs	"Malignant tumor." Left adrenal. Author called the tumor "hypernephroma." Thymus had disappeared
17	MacCarty: Berl. klin. Woch., 1905, vol. 42, p. 115	Not stated	2 yrs. 6 mos.	8 weeks	Left	Yes	Not stated	Not stated	Protuberance anterior part of head. Fever throughout. Right sided exophthalmos	None	Skull, left axilla	Malignant "hypernephroma"

TABLE OF ADRENAL TUMORS IN CHILDREN (Continued)

No.	Name and Reference	Sex	Age	Duration of Disease	Side	Tumor and Duration	Pain	Hematuria	Special Symptoms	Operation	Metastases	Pathologic Condition
18	Ogle: Tr. Path. Soc., Lond., 1865, vol. 16, p. 250	Female	3 yrs.	Not stated	Left	Yes	Not stated	Not stated	Very stout. Weighed 44 lbs. 2 ft. 10 in. high. Sullen look. Large amount of hair over whole body. Mustache on upper lip. Curly hair on genital regions. Skin coppery, but not pigmented	None	Not stated	Large tumor weighing 2 lbs.
19	Orr: Edin. Med. Jour., 1900, n. s. VII., vol. 50, p. 221	Female	2 mos.	3 mos. 2 wks.	Left	Yes	Not stated	Not stated	Fairly well nourished at first; later, emaciated. Gradual death	None	Liver	"Sarcoma." Malignant type of tumor
20	Orth: "Arbeiten aus dem Path. Institut. zu Göttingen," Berl., 1893, p. 75	Female	4 yrs. 6 mos.	2 yrs. 6 mos.	Right	Yes	Not stated	Not stated	Large amount of pubic hair. External genitals precociously developed. Clitoris was like a small penis	None	Lungs and liver	Malignant tumor of the adrenal. Tumor was of large size
21	Reiman: Prager med. Woch., 1902, vol. 27, p. 297	Not stated	6 mos.	6 mos.	Both sides	6 mos.	Not stated	Not stated	First symptom a small nodule on the lower abdomen	None	Skin, axillae, ears, buttocks, temporal bone, mammary glands, liver, thoracic walls, muscles, and various bones	There was a small tumor in either adrenal. That on the right was 4.6 cm. in diameter; that on the left, about 2 cm. in diameter. The microscopic structure showed that the tumor was of the malignant type

TABLE OF ADRENAL TUMORS IN CHILDREN (Continued)

No.	Name and Reference	Sex	Age	Duration of Disease	Side	Tumor and Duration	Pain	Hematuria	Special Symptoms	Operation	Metastases	Pathologic Condition
22	Ritchie: (Quoted by Bullock and Sequeira) Tr. Path. Soc., Lond., 1905, vol. 56, p. 197	Female	4 yrs.	Not stated	Not stated	Not felt	Not stated	Not stated	Genitals were thought to be hermaphroditic, but they were not, they were simply hypertrophied. Abundant pubic hair	None	Not stated	Structure of benign tumor of the adrenal
23	Tilesius: (Linser) Beitr. klin. Chir., 1903, vol. 37, p. 299	Female	4 yrs.	Not stated	Left	Not felt	Not stated	Not stated	Very fat and overdeveloped	None	Liver	There was a tumor in the left adrenal the size of a goose egg
24	Tilleston and Wollbach: Amer. Jour., Med. Sci., 1908, vol. 135, p. 871	Male	1 yr. and 4 mos.	5 mos.	Right	None found before death	None in abdomen	None	All in the orbital region	None in adrenal	Temporal bone	Sarcoma of the lymphocytoma class
25	Walker: (Richards) Guy's Hosp. Rep., 1905, vol. 59, p. 226	Female	7 yrs.	2 yrs.	Left	Yes	Not stated	Not stated	Became suddenly very stout. Growth of hair on face, chin, and pubes. Towards the end, became emaciated. Ascites	None	Liver	Malignant tumor of the adrenal

CHAPTER IX.

ACTINOMYCOSIS OF THE KIDNEY

ETIOLOGY

Actinomycosis is of most frequent occurrence in places where agriculture is carried on. Poncet and Bérard[1] assert that there are twice as many cases in Alsace-Lorraine, the Rhine Valley, and the Moselle Valley as there are in the mountainous districts, such as the Luxemberger, although in this latter place there may be many cattle. The disease is especially prevalent in a country which produces grain on a damp soil.

Many observers assert that the organism is occasionally normally growing in different kinds of grain, and that these grains eaten in the raw state are the exciting cause of the disease. This view is not in accord with the biologic characters in the true Actinomyces Bovis, as described by Wright,[2] and the chief argument against it is the fact that pure cultures of the organism are essentially anaerobic, and will either not grow well, or not at all, at ordinary room temperature. Still, the undoubted fact that the disease is especially prevalent in agricultural districts, and that there have been epidemics of the disease in localities where rye was raised on land recently reclaimed from the sea[3] would seem to indicate that the etiology of the disease is still obscure, and that further work must be done before it is entirely elucidated. The disease can be transferred from animals to man, and from man to other human beings, under favoring conditions. Poncet and Bérard[4] record a case in

[1] Bul. de l'Acad. de Méd., 3d series, 1903, vols. 49 and 50, p. 26.
[2] Jour. Med. Research, 1905, vol. 13,, p. 387.
[3] See Bang. Jensen, Tidsskrift for Veterinaerer, 1883, vol. 13, pp. 47, 100.
[4] Traité de l'Actinomycose Humain, Paris, 1898, p. 40.

which such contagion seemed beyond question. A case of this kind is also recorded by Rührah.[1] The disease starts in many instances in the vicinity of a carious tooth. The presumption here is that the microörganism gained a foothold through a lesion in the vicinity of the tooth. In other instances the tonsil has been the original seat of the disease. Any part of the skin may likewise give origin to the trouble. Occasionally the lung is primarily attacked, and in these cases the germ is supposed to have gained entrance along with particles of dust; numerous instances have been recorded in which the disease was supposed to have originated from the dust in barns in which grains have been stored for a long time. The habit of eating raw grains is supposed to be especially dangerous, but grains that have lain aside for a long time have been known to give rise to the affection. Eighty-nine per cent. of the cases occur between the month of June and the following January, at the time when agricultural pursuits are carried on. The frequency with which the disease occurs may be inferred from the statistics of Rührah.[2] In six hundred and twenty-eight cases analyzed by him, the head and neck were affected three hundred and fifty-seven times, or fifty-five per cent.; the digestive tract, one hundred and thirty-two times, or nineteen per cent.; the pulmonary tissue ninety-two times, or fourteen per cent.; the skin sixteen times, or two per cent. and there were thirty-three doubtful cases, or five per cent. These figures correspond closely with those given by many other observers.

BACTERIOLOGY AND PATHOLOGY

Actinomycosis was first described as a distinct disease in cattle by Bollinger.[3] The disease had formerly been considered to be tuberculosis, new growth, etc. Bollinger found

[1] Ann. of Surg., 1899, vol. 30, p. 422.
[2] Loc. cit., p. 431.
[3] Centr. f. die Med. Wissenschaften, Wien, 1877, vol. 15, p. 482.

the organism in the lymph glands of the neck, and Harz,[2] to whom the organisms were given for examination, pronounced them a new species, and he gave them the name Actinomyces Bovis, a name which they have retained to the present day. It was left for Ponfick[2] to show that the disease in man and animals is identical. Israel[3] had, previously to Ponfick, described the disease in man, but failed to classify the organism. Langenbeck[4] had also in 1845 described the disease in a man affected with prevertebral abscess. His accurate description of the characteristic yellow granules togther with drawings of the finer histologic structure, left no doubt as to the identity of the disease. Lebert[5] also gave an accurate drawing of the microörganism.

Wright[6] defines actinomycosis as a "suppurative process combined with granulation tissue formation, the pus of which contains the characteristic granules or 'drusen' composed of dense aggregates of branching filamentous microörganisms, and of their transformation or degeneration products. In the term 'transformation products' are included the characteristic refringent, club-shaped bodies radially disposed at the periphery of the granules. For these bodies have long since been clearly shown to arise by a transformation of the peripheral filaments. They may, or may not, however, be present at the periphery of the granules." According to Wright, the Actinomyces Bovis is distinguished from other microörganisms having somewhte similar characteristics, by the fact that the latter may have spore-like reproductive elements which the true Actinomyces Bovis does not have. These organisms have frequently been found growing in

[1]Jahresbericht des Königl. Central. Thierarznei Schule in München, 1877-1878, p. 125.
[2]Breslauer Arztliche Zeitsch., 1879, vol. 1, p. 116, and do. do. 1880, vol. 2, p. 151.
[3]Virch. Arch., 1878, vol. 74, p. 14.
[4]Quoted by Israel, Virch. Arch., 1878, vol. 74, p. 50.
[5]Traité d'Anat. Path. Gén., Atlas, Paris, 1857, vol. 1, plate 2, Fig. 16.
[6]Jour. Med. Research, 1905, vol. 13, p. 1349.

grains, grasses, etc. They are truly branching filamentous microörganisms growing aërobically in dense masses at room temperature, and they have "as a marked characteristic, transformation of the homogeneous non-septate filaments into chains of spherical bodies easily separable from one another, and constituting reproductive elements of the nature of spores." Some members of this group undoubtedly cause suppurative processes, cases of which have been described by Nocard, Eppinger, Dessy, and others. "In contradistinction from the true Actonomyces Bovis Wright states that these microörganisms do not occur in the lesion in characteristic compact colonies, like the microörganisms of Actinomyces Bovis. Their occurrence in such suppurative processes has also lent weight to the widely prevalent belief that actinomycosis is due to infection with microörganisms of this group. To the members of this group the names, Stereptothrix, Nocardia, Cladothrix, Oospora, have been given." Wright[1] believes that the only one of these names, according to well recognized principles of nomenclature, tenable to the group, is "Nocardia,"[2] because the other names have been previously used for plant genera to which these microörganisms clearly do not belong. "The pathologic condition which is caused by the 'Nocardia,' should be called 'Nocardiosis,' in contradistinction to Actinomycosis. A 'Nocardia' has never been shown to have formed characteristic structures either in man or in animals, such as are produced by Actinomyces Bovis."

According to Wright, the Actinomyces Bovis probably exists in the form of fragmented filaments growing in company with bacteria of the gastro-intestinal tract.[3] Wright, however, is not able to give any direct proof of the correctness of this view. The fact, however, that the specific or-

[1]Loc. cit., p. 385.
[2]See de Toni and Trevisan, Saccardo Sylloge Fungorum, 1889, vol. 8, p. 927.
[3]Loc. cit., p. 387.

ganism described by him has never been found outside the animal body, and especially the fact that when grown in culture it exhibits anaerobic qualities, not growing well, or not at all, at room temperature, would seem to favor this view. Israel[1] is also of the opinion that "under certain conditions the malignant microörganisms may develop from the harmless leptothrix found in the mouth." Wright believes that the grains and other foreign bodies sometimes found in the lesion in cases of actinomycosis have, in the first instance, merely produced an abrasion which offers a favorable nidus for the propagation and growth of the organism, and that these grains are not in fact the carriers of the organism. The microörganism grows in the characteristic aggregations of branching filamentous masses previously described. These masses are from 1 to 2 mm. in diameter. They are usually of a sulphur yellow color, but they may be grayish or even greenish. When examined under the microscope, after being pressed out, they show a marked radiating characteristic, and this is due to the arrangement taken by the closely packed threads; these threads are sometimes, but not always, clubbed at their extremities; the clubbed arrangement is due merely to a swelling, and is to be considered a secondary change, as already mentioned. The various cocci, spores, and other bacteria formerly thought to be connected with the organism have been clearly shown by Wright[2] not to be a component part, and this author looks upon such as either products of degeneration or disintegration of the filaments of the specific microörganism, or real micrococci and bacilli growing in symbiosis with it.[3]

The process in the organ affected is one of inflammation, with granulation tissue. The inflammation is destructive, and consequently has a marked tendency to

[1]Quoted by E. M. Skeritt, Am. Jour. Med. Sci., 1887, n.s., vol. 93, p. 76.
[2]Loc. cit., p. 395.
[3]Loc. cit., p. 398.

spread to surrounding tissues and organs. Occasionally the microörganism remains encapsulated by dense inflammatory tissue which acts as an envelope, and the disease comes to an end by calification. This is an unusual result. The pathologic process in this disease has nothing whatever in common with those of the infective granulomata, and the lesions produced are essentially and purely of an inflammatory character.

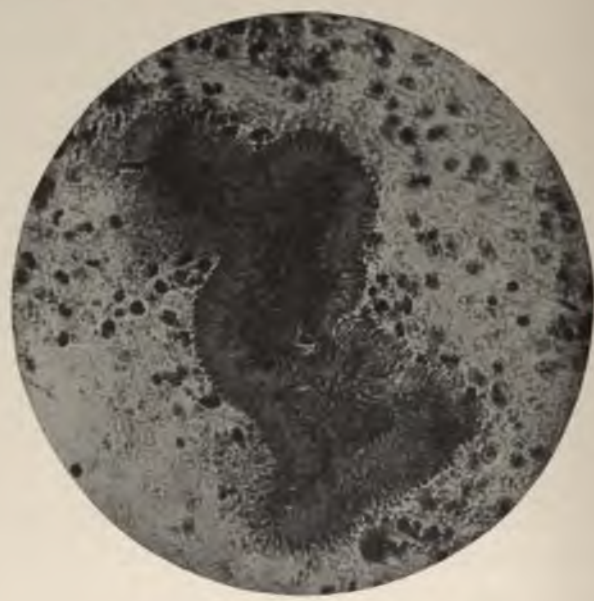


Fig. 42.—A Colony of Actinomycosis in the Renal Parenchyma, showing the characteristic edge. From the Bender Lab'y at Albany, New York. Case of Dr. E. MacD. Stanton.

The first effect of the organism is to produce a violent inflammation in the part in which it is growing. There is an intense round cell infiltration in the vicinity, and likewise a proliferation of the fixed tissue cells. Later, the cells around the colony undergo hyaline degeneration and necrosis; when this has taken place the colony is of fairly large size, and its center undergoes a necrosis; as a result it has the appearance of hollow ball formation (Fig. 42). Epi-

thelioid cells may now be found at the periphery. A later stage in the process is fibrous tissue formation, and this sometimes is of a very extensive character, and serves in some cases as a limiting bulwark to further extension. While this may occur in the harder tissues of the face and neck, it is of great rarity in cases in which the disease has attacked internal organs, such as the lungs, etc. As a rule, new colonies begin to grow along the line of least resistance and the disease spreads rapidly by extension; there is gradual softening and abscess formation, and the final result is bursting of the abscess externally, and the formation of a sinus which discharges pus in which are found the characteristic small, yellow granules which make up the separate colonies of the organism. The destructive process may be very extensive, and in these cases the disease may travel for quite a distance. It may start in the jaw, extend along the neck, gain a foothold in the lung, travel through it, attack the diaphragm, and invade the abdominal organs. The coexisting pathogenic bacteria found with the actinomyces undoubtedly play an important part in the extension of the disease in these malignant cases. Occasionally the organism is carried to distant parts of the body by metastasis, but it is far commoner to observe extension by continuity. When metastasis occurs it takes place through the blood vessels rather than through lymphatic channels, although occasionally the latter may serve to spread the disease. It is not always easy to decide at once the relation between what appears to be the original focus, and a metastatic deposit. Occasionally the metastasis is taken for a primary lesion, for, as is well known, the primary lesion may heal and leave no trace except a scar, and yet this primary lesion may have given rise to a metastasis which is the cause of death.

It is doubtful if the kidney is ever the first organ attacked, and the disease probably always reaches the organ by metastasis or by continuity. In the reports of one hun-

dred and twenty-eight autopsies, collected from various sources, in which there was actinomycosis of some organ, the writer found mention of undoubted actinomycosis in the kidney in eleven instances, or 8.6 per cent. (Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 and 11). There were eleven cases in which the disease was by continuity (Nos. 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, and 22). There were two cases of doubtful primary actinomycosis in the kidney (Nos. 23 and 24), and there was one ureteral case (No. 25). Besides these autopsy cases there were two single instances of doubtful primary actinomycosis of the kidney, with recovery (Nos. 40 and 41). In Earl's case (No. 23) the only evidence that the kidney was the primary seat was the fact that the lesion here seemed to be older than the one found in the brain.

Stanton believed that the origin of the kidney actinomycosis in his case (No. 24) was a lesion of the colon, for at the autopsy a small scar-like area with peritoneal adhesions was found, suggesting a previous inflammatory condition. In Israel's case (No. 40), which will shortly be reported in full, although the kidney lesion was the only one found, yet Israel himself thought that the primary lesion had probably not been in the kidney, and hinted that the disease might have started about the mouth, from the fact that his patient had all his molar teeth in an advanced stage of caries. Kunith made the same admission in regard to his case (No. 41). *It is more than probable, therefore, that the kidney is never the primary seat of the disease.*

The appearance in the early part of the process in the metastatic form in the kidney is that of miliary globular areas the size of a millet seed, scattered about in the kidney substance. These areas are found either singly or in groups, and generally in the cortex of the kidney. The bodies are usually pale yellow in color, or they may be brown or green, and their edges have the appearance of palisade-like rows of clubbed bodies which give them a mulberry-like appear-

ance. In the center of this spot is the growing filamentous organism, which, as already described, spreads out in a radiating manner, and terminates, in some instances, in clubbed bodies. As the colony grows it excites intense inflammation with round cell infiltration. Softening and abscess formation result, and if there are several colonies growing close together there may be coalescence, and finally an abscess of fairly large size is formed, in which the loosened colonies are floating about as the characteristic yellow granules.

The tendency is not toward the formation of an abscess of large size, but rather toward the formation of many abscesses of small size. Between the abscess cavities the kidney substance is greatly changed. There is abundant formation of granulation tissue in which leucocytes and lymphoid cells are found. The tendency of the granulation tissue to proliferate is very great, and hyaline degeneration is seen in places. There is also atrophy and cicatricial formation of this tissue. The glomeruli are transformed into homogeneous masses by the destruction of their capillary loops, and the urinary tubules are compressed. In some of the vessels of the glomeruli are found infarcts of the organism, the size of the micrococci. In many instances the infarction involves only one loop, in other places the greater part of the glomerulus. The affected loops are swollen by the granules. The result of these changes is a tissue of considerable density, amounting sometimes to scirrhous formation. Finally the pelvis may be reached by the process, and in this event pus is discharged, which mingles with the urine and is carried away with it. The final result is considerable enlargement of the kidney at the part affected by the disease, and there may be distinct bulging in this area rising above the capsule. In other instances the density of the tissue is not so great, and in these cases the suppurative processes give the diseased area a softer consistence.

The metastatic form is almost always seen as a complication of the disease of internal organs. In only one instance

(No. 13) was it found that the disease in the kidney originated from metastasis from the *surface* of the body, and in this case the jaw was affected.

When the disease has invaded the kidney by continuity, adhesions are found between the kidney and the affected surrounding structures, and if there is an abscess cavity which is formed by the dissolution of the tissues of the neighboring organs, the pus in this cavity bathes the surface of the kidney. In such instances the abscess may find its way externally, and a sinus is formed, which discharges the pus mixed with the yellow granules. The lesions affecting the kidney itself in these cases do not differ essentially from the usual actinomycotic lesions under similar circumstances. There is thickening of the capsule, and, in places, the disease attacks the capsule, showing erosions and eaten away places. The process finally overcomes the obstruction offered by the capsule and invades the parenchyma of the kidney. The process continues, and there is likewise abscess formation. In the end, the pelvis is reached, and when this occurs the pus finds its way to the bladder with the urine. The kidney may be reached by continuity as the result of the presence of the disease in the organs in the vicinity, and this may result from actinomycosis of the liver, spleen, stomach, and intestine. The appendix has been the source of the disease in the kidney in a number of instances, and the inflammation in these cases traveled along the subperitoneal space. The first recorded case of actinomycosis in the human being was that in a patient with a prevertebral abscess which was in direct contact with the kidney. This case was observed by Von Langenbeck, who described its details in 1845.[1] An extraordinary case of infection of the kidney is related by Hoover.[2] The disease started in the jaw and traveled down the neck to the clavicular region, reached the lung by invasion of the chest wall, traveled

[1]See Israel, Virch. Arch., 1878, vol. 74, p. 50.
[2]See Rührah, Ann. of Surg., 1899, vol. 30, p. 438.

through the lungs, and perforated the diaphragm, attacked the liver, finding its way through it to its lower surface, and eventually reached the kidney (see Case No. 4).

Among the secondary degenerations which may attack the kidney, amyloid is the most common. This is occasionally seen in cases of actinomycosis of the kidney, and it usually affects both organs. It is much more common, however, to find amyloid degeneration affecting the kidney in case of actinomycosis in other parts of the body. West[1] is of the opinion that amyloid degeneration of the kidney must be due to the disease itself for it has not been noted to be a special feature in cases of long standing suppuration, nor is it always present in cases in which pus has been discharged in large amounts. A secondary nephritis is not uncommon, the nephritis being of parenchymatous variety; fatty degeneration may also occur.

Actinomycosis affecting the ureter is of great rarity, and only one instance is recorded in literature (see Case No. 25). Ammentorp[2] records the case of a male, twenty-five years of age, with an actinomycotic retrocecal abscess. The disease attacked the bladder and also the right ureter.

SYMPTOMS

The symptoms of actinomycosis affecting a kidney which is the only organ seriously affected vary according as the disease is localized in the kidney, or according as there is general systemic infection; in the first event the symptoms are those of a mild, suppurative nephritis; in the second, we may suspect secondary infection with another germ, giving rise to severe pyelonephritis, with general septicemia.

Israel's[3] case (No. 40) illustrates the first of these types. This patient was an army officer, aged thirty-three, of previous good history. Following a long march in cold winter

[1]Tr. Path. Soc., London, 1897, vol. 48, p. 23.
[2]Centr. f. Chir., 1894, vol. 21, p. 1074.
[3]Chirurgische Klinik der Nierenkrankheiten, Berlin, 1901, pp. 270, 271.

weather, hematuria suddenly appeared, together with a dull pain in the left kidney region. At first the hematuria was persistent and had the peculiarity that clear urine alternated with the blood on the same day. This attack lasted several weeks, and then there was an intermission during which no blood at all appeared. Sensitiveness in the kidney region was present on exertion. At first the general symptoms were slight; there was neither fever nor loss of weight. An exploratory incision by another surgeon was made on the left side, and nothing apparently was found; but the examination of the kidney was incomplete, owing to the fact that it was situated high up, and could not be easily pulled down. Pyuria soon appeared after this operation; this persisted, and was improved only by drinking large amounts of water. The patient did fairly well after the operation, but there was still pain, and a year after the nephrotomy, after violent exercise, the hematuria not having occurred in the interval, it again appeared. With the recurrence of this symptom, there was high fever with chills, anorexia, weakness and diarrhea. There soon succeeded colicky pains in the abdomen, and the patient was obliged to take to bed. Improvement followed rest in bed, and the patient was able to get about again. Three years later there appeared in the scar of the old operation wound a number of small lumps, one of which was incised, and a permanent fistula was established. On examination of the pus discharged from this sinus yellow granules were discovered, which suggested actinomycosis, and the microscope confirmed the suspicion. The patient at this time was in very bad condition; was poorly nourished, and exhibited striking anemia of the mucous membranes. On examination, a fistula extending upward and inward was found, and underneath the left ribs a hard mass was felt, somewhat uneven in shape, but not sensitive. The urine at this time was cloudy, acid, and contained an abundant sediment of pus. A careful examination of the sediment showed little yellow particles and larger

threads of pus. There were also fine gray nodules which sank to the bottom of the vessel, and which on examination were seen to be sharply circumscribed accumulations of leucocytes, in the center of which there was a zooglear mass. Many of the nodules were calcified in the center. On treating with hydrochloric acid there appeared a central zooglea from which in one case could be seen the fine threads projecting beyond the margin of the mass. A number of pear-shaped clubs were also found. The amount of urine varied from 1500 to 1800 c.cm., with a specific gravity of 1014 to 1016. An operation was performed and the kidney was removed. The lower part of the organ was practically unchanged; the upper two-thirds presented the characteristic pathologic appearances. In the pelvis there was found a calculus which on examination showed, after treatment with potassium salts, characteristic rod-like forms. Israel describes the calculus as a "fossilized mass of microörganisms." The patient recovered quickly from the operation and in a few months was well. Israel thought that the gum around a carious tooth might have been the starting point of the disease in this case.

Kunith's[1] case (No. 41) was somewhat similar. The patient was a male child, aged four and one-half years. When one year old he resided in the country for a short time. Ten months before admission to the hospital he fell from a swing and since then he had a swelling in the right lumbar region. This was twice opened and pus was evacuated. Two fistulae remained. There was some cystitis following these operations. The true condition was not suspected when the nephrectomy was performed. The operation was successful and the child recovered and was well eleven months later. A few days after the nephrectomy the urine was examined and typical granules were discovered. The extirpated kidney was enlarged, nodular, and hard. On section, small grass-green granules exuded from the tissue.

[1] Dtsch. Zeit. f. Chir., 1898, vol. 92, Part I., p. 181.

Almost the entire kidney, with the exception of the upper and lower portion, was riddled with small grayish-white abscess cavities embedded in coarse connective tissue. At the upper pole were cavities filled with fresh blood and at the lower pole there was fatty degeneration. The microscope disclosed a typical picture of actinomycosis.

In this case Kunith remarked on the presence of carious molar teeth in the lower jaw, but he was more inclined to attribute the renal infection to a concealed focus in another part of the body, although he does not state that any such focus was found.

Stanton's[1] case was one in which there was general infection. The patient was a male fifty-three years of age, who, two months before admission to the hospital, began to have difficulty in passing urine. While in the hospital the patient ran an irregular temperature, ranging from 99 to 103 degrees F., and was slightly irrational the greater part of the time. There was severe general prostration, drowsiness, skin dry, an enlarged flabby tongue covered with a white fur, and there was a fine tremor. Abdominal examination was entirely negative, there being no sensitiveness in any part. The urine showed an abundant quantity of pus, but this was thought to be due to cystitis. At the autopsy, a large right kidney was found; the capsule stripped with difficulty, leaving a grayish yellow cortex with deeply injected stellate veins. On section, the pelvis was found filled with a thin, grayish yellow, purulent fluid, and the pyramids and adjacent cortex were streaked with grayish yellow lines of purulent infiltration. In many places the areas of suppuration were confluent, forming abscesses 0.5 to 1 cm. in diameter, filled with thick pus containing fragments of necrotic tissue. Microscopic examination showed, on section through the abscesses in the pyramids and cortex, irregular areas of suppuration. These areas were composed of polynuclear leucocytes and cell detritus, in the midst of

[1] Am. Medicine, 1906, vol. 11, p. 401.

which were seen numerous typical actinomyces with well developed clubs. Examination of the bladder showed a severe general inflammation extending well into the deeper layers of the bladder wall. The left kidney showed slight chronic diffuse nephritis. Stanton thought that the primary focus in this case might have been in the intestine, for at one point was a healed scar.

In Earl's[1] case there was, with the kidney lesion, an actinomycotic cerebral abscess, from the effects of which the patient died. In this case there were no symptoms referable to the right kidney, although at the autopsy it was found to be the seat of a very extensive actinomycotic process which, judging from the general appearance, was much older than that of the brain. Earl was of the opinion that the disease might have originated here. No other focus was found in the body.

These four cases of actinomycosis of the kidney are the only ones of the kind recorded in literature on the subject.

A patient affected with metastatic actinomycosis of the kidney which is secondary to the much more serious primary lesion in other organs does not, as a rule, exhibit symptoms of a localizing character in the kidney. In such cases the lesion in the kidney is usually not far advanced, and death takes place in consequence of exhaustion caused by extensive lesions elsewhere before the renal complication has had opportunity to increase in extent. The picture of a patient suffering from severe forms of actinomycosis of the internal organs, in which the kidney may be but one of those affected, is that of a chronic septicemia. The disease is a most serious one, and the bodily health is extensively undermined. There is extreme emaciation, prostration, sleeplessness, disturbed bodily functions, fever of an irregular character, going as high sometimes as 103° to 104° F., chills, and the peculiar facies found in connection with suppurative processes. Usually there is a leucocytosis.

[1] Tr. Royal Acad. Medicine, Ireland, 1905, vol. 23, p. 342.

Toward the end of the trouble the chills, sweats, and other symptoms become more pronounced; delirium is more persistent, and jaundice and diarrhea may be seen, both of which tend to a speedy termination. Death is from exhaustion, and it may be by sudden collapse.

Should the kidney become seriously involved in the process it will be very difficult to determine this, because the symptoms just enumerated are practically identical with those of the pyelonephritis which ensues. Muttering delirium is suggestive of pyelonephritis, and so also is the increased drowsiness, amounting to coma towards the end. Examination of the urine should not be neglected in these cases and the presence of pyuria with actinomycotic granules is positive evidence of the disease in the kidney.

DIAGNOSIS

The diagnosis can seldom be made. Most reliance may be placed upon the urinary findings. The discovery of the microörganism in the urine is conclusive evidence of the disease in some part of the urinary tract, and having made the discovery it remains to demonstrate the source of infection by the usual instrumental means. The presence of the disease elsewhere in the body, for instance, in the lungs or skin, should lead to a long-continued series of urinary examinations. The kidney in these instances may be suspected to be involved, if there is pain under the ribs or in the hypochondriac region; but here also one must bear in mind the possibility of the disease affecting other organs in the vicinity.

TREATMENT

If the diagnosis is made early enough, and there are no contraindications to an operation, a nephrectomy may sometimes be the means of saving the patient's life, as in Israel's and Kunith's cases. When, however, there are serious complicating lesions in other parts of the body the

question of nephrectomy deserves careful consideration. There are few cases in which this procedure is justifiable. The disease is usually so serious when it has gotten to the point where the kidney is secondarily attacked, that mere palliation is usually all that can be done. The administration of iodide of potassium was at one time thought to offer hope in this disease, but this drug has not proved very useful in the light of experience. It may, however, be tried. Arsenic may be used in conjunction with it. If anything is to be expected from the iodide of potash, it should be given in large doses, as much as 6 grammes daily, in gradually increasing doses, if the patient will stand it. It seems to do most good in the early stages.

PROGNOSIS

The prognosis is very bad. This is due to the fact that the kidney is usually attacked late in the course of the disease in one of the internal organs. The involvement of the kidney under these circumstances hastens the end. Duvau[1] in a list of two hundred and fifty-five cases of actinomycosis affecting the various parts of the body, estimates the mortality in the thoracic form at eighty-five per cent., and in the abdominal form of intestinal origin, at sixty-five per cent. If the disease is primary in the kidney and the process has not extended beyond the capsule, nephrectomy offers hope of cure.

The following tables, compiled from reports of cases in which autopsy was performed, show the frequency with which the kidney is attacked, and also, briefly, the nature and extent of the pathologic changes.

CASES IN WHICH KIDNEY INFECTION WAS BY METASTASIS

Case 1. J. Israel's[2] case in a female thirty-nine years of age. Primary lesion, lung. Secondary lesions, both

[1] Th. de Lyon, 1902, p. 100.
[2] Virch. Arch., 1878, vol. 74, p. 15.

kidneys. The right kidney slightly enlarged, pale; cortical substance showed numerous abscesses; these were absent in the medullary substance, and lay mostly in groups. The larger abscesses were formed by confluence of the smaller ones, and this was recognized by the fact that they had a sinuous outline. There was much pus, and there were masses of the microörganisms.

Case 2. J. Israel.[1] Female; age, thirty-one. Primary lesion, doubtful. Secondary lesions, heart, breast, spleen, liver, brain, and left kidney. The kidney showed on its surface a number of confluent foci consisting of miliary abscesses which contained the typical pus.

Case 3. O. Israel.[2] Female; age, forty-four. Primary lesion, doubtful. Secondary lesions, lungs, diaphragm, spleen, stomach, one kidney (?). There was a "granulating neoplasm in one kidney."

Case 4. Köhler.[3] Adult female. Primary lesion, skin. Secondary lesions, brain, tongue, spleen, kidneys, colon. There were abscesses in the cortical substance of both kidneys.

Case 5. F. B. Mallory.[4] Adult male. Primary lesion, doubtful. Secondary lesions, liver, lungs, kidneys, brain. The kidneys were large; cortex hyperemic; in both there were several circumscribed abscesses, some the size of a pea, and others of a cherry. Small amount of necrotic tissue.

Case 6. Martin.[5] Male, age sixteen. Primary lesion, mouth. Secondary lesions, brain, lungs, both kidneys. There were minute abscesses in both kidneys, chiefly in the cortex in isolated patches. Parenchymatous degeneration existed everywhere. The abscesses were composed merely of masses of small round cells, containing in some instances giant cell formation. The invading microörganisms were

[1]Berl. klin. Woch., 1884, vol. 21, p. 361.
[2]Berl. klin. Woch., 1888, vol. 25, p. 71.
[3]Berl. klin. Woch., 1884, vol. 21, p. 414.
[4]Boston Med. and Surg. Jour., 1895, vol. 132, p. 296.
[5]Jour. Path. and Bact., 1894-1895, vol. 3, p. 81.

likewise found in the center of one of these abscesses in the immediate neighborhood of a glomerulus, being in an early stage of development. It was composed chiefly of filaments, and manifested but little evidence of club formation.

Case 7. Moody.[1] Male, age forty-three. Primary lesion, upper jaw. Secondary lesions, liver, suprarenal capsule of left kidney. The disease started in the upper jaw, and metastasis was to the right lobe of the liver through the diaphragm and involving the suprarenal capsule of the left kidney. There was a suppurating process in the kidney.

Case 8. Moosdorf.[2] Male, age twenty-one. Primary lesion, lung. Secondary lesions, kidney and heart. The left kidney was considerably enlarged, especially at its upper part, and contained a focus the size of a fist, which projected outward and had taken the place almost of the entire kidney substance, projecting likewise into the pelvis. It consisted of a tenacious mass of yellow granules.

Case 9. Petroff.[3] Male, age twenty-six. Primary lesion, jaw. Secondary lesions, both kidneys. On the posterior surface, lower third, was a large tumor which pressed the left kidney forward; the kidney was adherent to surrounding tissues, and its posterior surface was destroyed. The renal tissue here showed cicatricial thickening with yellowish nodules. In the right kidney there was a large focus with several pus cavities.

Case 10. Poncet and Bérard.[4] Male, age forty-eight. Primary lesions, lungs. Secondary lesions, miliary abscesses in the kidney.

Case 11. Sabrazès and Rivière.[5] Male, age thirty-two. Primary lesion, doubtful. Secondary lesion, brain, suppurating kidney infarct.

[1]Jour. Path. and Bact., 1903, vol. 8, p. 239.
[2]Jahresbericht der Gesell. f. Natur. und Heilk., 1872, Apr. 22, p. 86.
[3]Berl. klin. Woch., 1888, vol. 25, p.542.
[4]Traité Clinique de l'Actinomycose Humain, Paris, 1898, p. 239.
[5]La Presse Médicale, 1894, Sept. 22, p. 302.

CASES IN WHICH INFECTION WAS BY CONTINUITY

CASE 12. Grill.[1] Female, age twenty-five. Primary lesion, right lumbar region. Secondary lesions, appendix, right kidney. The right kidney had several purulent foci in it.

CASE 13. Grill.[2] Female, age twenty-five. Primary lesion, cecal region. Secondary lesions, liver and kidney.

CASE 14. Aschoff.[3] Female, age not given. Primary lesion, lungs. Secondary lesions, liver, left kidney. The capsule of the kidney was gelatinous and transparent, the organ pale and cloudy. The capsule of the right kidney was thicker than that of the left, and there were gray nodules in a small area on its surface.

CASE 15. Hoover.[4] Male, age forty-three. Primary lesion, jaw. Secondary lesions, neck, chest, lungs, liver, spleen, both kidneys. In this case the disease started in the jaw, traveled down the neck to the sternal region, invaded the lungs through the ribs, traveled down to the diaphragm, through it to the liver, and finally to the kidneys.

CASE 16. Rowland.[5] Male, age twenty-two. Primary lesion, gum (carious tooth). Secondary lesions, lung, left kidney, cecum, appendix, thigh. The capsule of the left kidney was adherent below and behind; there was an abscess cavity leading from the left loin to the surface of the body. There were three deposits of actinomycosis in the lower third of the organ, and the pelvis contained pus. There was amyloid in both kidneys.

CASE 17. Vanderstreaten.[6] Male, age twenty-two. Primary lesion, lungs. Secondary lesions, right kidney, liver. The kidney was in direct contact with the liver, and the disease had extended from the liver to the kidney. The upper part was grayish in color. Section of the right kidney

[1] In. Dis., Tüb., 1895, p. 10.
[2] Barth. Beitr. z. klin. Chir., Tübingen, 1895, vol. 13, p. 560.
[3] Berl. klin. Woch., 1895, vol. 32, p. 765.
[4] Quoted by Rürah, Ann. of Surg., 1899, vol. 30, p. 438.
[5] Lancet, 1902, vol. 2, p. 671.
[6] Bul. de l'Acad. Royale de Méd. de Belgique, 1891, No. 8.

showed purulent infiltration and destruction of tissue in its upper anterior surface.

CASE 18. Ponfick.[1] Female, age twenty-four. Primary lesion, tonsil. Secondary lesions, lungs, diaphragm, liver, both kidneys. There was an abscess in both kidneys.

CASE 19. Grill.[2] Male, age fifteen. Primary lesion, rectum. Secondary lesion, appendix. There was an abscess from the appendical region, extending up to the space behind the kidney, and invading the peritoneum.

CASE 20. Langenbeck.[3] Adult male. Primary lesion, doubtful. Secondary lesion, prevertebral abscess on the left side. The abscess cavity was in direct contact with the left kidney.

CASE 21. Grill.[4] Male, age fifty. Primary lesion, appendix. Secondary lesions: there was an abscess reaching up to the kidney, and also a metastatic liver abscess.

CASE 22. Grill.[5] Male, age fifty-two. Primary lesion, colon. Secondary lesions: there was a focus reaching to the kidney, and there was an abscess in the liver. The abscess posterior to the colon reached up to the kidney.

CASES IN WHICH THE KIDNEY WAS PRINCIPALLY AFFECTED

CASE 23. Earl.[6] Male, age forty-nine. Primary lesion, kidney (?). Secondary lesion, brain. The lower third of the kidney was occupied by a grayish, firm mass, in which there were seen a number of small cavities, generally lying in groups, and containing thick, yellowish pus. The kidney was slightly adherent to the quadratus lumborum, and this was due to the extension of the process to this point.

CASE 24. Stanton.[7] Male, age fifty-three. Primary lesion, intestine (?). Secondary lesion, kidney. The pyra-

[1] Berl. klin. Woch., 1880, vol. 17, p. 605.
[2] Barth, Beitr. z. klin. Chir. Tübingen, 1895, vol. 13, p. 565.
[3] Quoted by Israel, Virch. Arch., 1878, vol. 74, p. 50.
[4] Ransome, Beitr. z. klin. Chir., Tübingen, vol. 13, p. 56.
[5] Uhlmann, Beitr. z. klin. Chir., Tübingen, 1895, vol. 13, p. 565.
[6] Tr. Royal Acad. Medicine, Ireland, 1905 vol. 23, p. 342.
[7] Am. Medicine, 1906, vol. 11, p. 401.

mids and cortex were streaked with yellowish gray lines of purulent infiltration; in many places the areas were confluent, forming abscesses .5 to 1 cm. in diameter, filled with thick pus. On microscopic examination, typical colonies were found with well developed clubs.

URETERAL CASE

CASE 25. Ammentorp.[1] Male, age twenty-five. Primary lesion, appendix. Secondary lesions, bladder, right ureter, retrocecal region.

CASES OF ACTINOMYCOSIS IN OTHER PARTS OF THE BODY, NOT AFFECTING THE KIDNEY, BUT GIVING RISE TO LESIONS SECONDARY IN THE KIDNEY

CASE 26. Von Baracz.[2] Male, forty-five years old. Primary lesion, lungs. Secondary lesions, retrobronchial glands, ribs, and sternum. The kidney showed a slight degree of fatty degeneration.

CASE 27. Poncet and Bérard.[3] Male, thirty-seven years old. Primary lesion, liver. Secondary lesion, lungs. There was chronic parenchymatous nephritis.

CASE 28. Duckworth.[4] Male, nineteen years old. Primary lesion, lungs. Secondary lesion, diaphragm. There was slight congestion of both kidneys.

CASE 29. Grill.[5] Male, twenty-six years old. Primary lesion, stomach. Secondary lesions, lungs, ribs, spleen, diaphragm, pericardium, abdominal wall, chest muscles, upper arm. The left kidney was large, firm, and anemic. The right kidney was smaller and much congested.

CASE 30. Hanau.[6] Female, forty years old. Primary lesion, lungs. Secondary lesions, vena cava, and pericardium. Kidneys large and hard.

[1] Centr. f. Chir., 1894, vol. 21, p. 1074.
[2] Arch. f. klin. Chir., 1902, vol. 68, p. 1095.
[3] Boari, Traité de l'Actinomycose Humain, Paris, 1898, p. 294.
[4] St. Barth. Hosp. Reports, vol. 31, p. 23.
[5] Beitr. z. klin. Chir., Tübingen, 1895, vol. 13, p. 552.
[6] Schweizer Corres. Bl., 1889, No. 6.

CASE 31. Grill.[1] Male, twenty-eight years old. Primary lesion, ascending colon. Secondary lesions, liver and both lungs. There was a question as to amyloid of the kidneys.

CASE 32. Koch.[2] Male, twenty-eight years old. Primary lesion, lungs. Secondary lesions, pleura, diaphragm, colon, spleen, and peritoneum. There was chronic nephritis and beginning parenchymatous degeneration.

CASE 33. Langhans.[3] Male, fifty-one years old. Primary lesion, cecum and appendix. Secondary lesion, liver. The kidneys were large and congested.

CASE 34. Partsch.[4] Male, thirty-five years old. Primary lesion, cecum. Secondary lesion, hip joint. There was amyloid degeneration of both kidneys.

CASE 35. Partsch.[5] Male, thirty-two years old. Primary lesion, skin. Secondary lesions, intestines and liver. Amyloid degeneration of the kidneys.

CASE 36. H. W. Rowland.[6] Male, twenty-seven years old. Primary lesion, cecum. Secondary lesion, lungs. Fatty degeneration of the kidneys.

CASE 37. Sammter.[7] Male, thirty years old. Primary lesion, lungs. No secondary lesion. Amyloid degeneration of the kidneys and the spleen.

CASE 38. Schabad.[8] Male, sixty-two years old. Primary lesion, lungs. Secondary lesions, pleura, ribs. There was chronic interstitial nephritis.

CASE 39. Weigert.[9] Male, thirty-five years old. Primary lesion, skin over the ribs. Secondary lesions, pleura, diaphragm and liver. The kidneys were large and amyloid degeneration was present.

[1]Lunning and Hanau, Beitr. z. klin. Chir., Tübingen, 1895, vol. 13, p. 565.
[2]Münch. Woch., 1894, Nos. 8 and 9.
[3]Corres. Bl. f. Schweizer Ärzt., 1888, vol. 18, p. 330.
[4]Dtsch. Zeit. f. Chir., 1886, vol. 23, p. 517.
[5]Dtsch. Zeit. f. Chir., 1886, vol. 23, p. 513.
[6]Lancet, 1902, vol. 2, p. 671.
[7]Arch. f. klin. Chir., vol. 43, p. 257.
[8]Zeit. f. Hygiene, 1904, vol. 47, p. 54.
[9]Virch. Arch., 1881, vol. 84, p. 303.

CASES IN WHICH THE ONLY LESION IN THE BODY WAS THE KIDNEY; IN WHICH THERE WAS RECOVERY. PRIMARY LESION SUSPECTED TO BE THE GUMS

CASE 40. J. Israel.[1] Male, thirty-three years old. Primary lesion, probably the gums. Patient had carious molar teeth, and the disease was suspected to have had origin in the gums.

CASE 41. Kunith.[2] Male, age four and one-half years. Primary lesion, probably gums(?). Patient had carious molar teeth.

[1]Chir. Klinik der Nierenkrankheiten, Berlin, 1901, pp. 270, 271.
[2]Dtsch. Zeit. f. Chir., 1908, vol. 92, part 1, p. 181.

CHAPTER X.

ECHINOCOCCUS OF THE KIDNEY

Echinococcus disease has been known and recognized a long time. Bose[1] describes the autopsy of a female, thirty-five years old, at which a large tumor of the right kidney was found, in which were hydatid cysts.

Echinococcus disease in man represents the cysticercus stage of development of the tenia echinococcus, a parasite which inhabits the intestines of certain animals, notably the dog.

The parasite is a cestode, and is peculiar in that it usually requires two hosts for its complete development, although, as we shall see, in exceptional instances, a single host serves for both its primary and secondary stages.

The zoölogic characters of the tenia echinococcus were first made plain by Siebold,[2] who traced the parasite through its full cycle from animal to man.

In the dog and in other animals which it infests, e.g., the pig, sheep, ox, etc., to the number of about twenty-seven, the tenia usually lives in the first part of the intestinal tract near the duodenum. It fastens itself to the intestinal wall by means of little hooklets and suckers which it has on its head, and remains there. This tenia has never been found in the intestinal canal of the human being. The disease in man is caused by the ingestion of the eggs of the tenia which get into the human system in various ways, and these eggs find their way from the stomach to the different parts of the body. Wherever the ovum is arrested it may grow, and form the typical echinococcus cyst.

[1] De Rene per Hydatidem penitus destructo, Leipsic, 1780, p. 5.
[2] Ueber d. Verw. der Echinococcus-Brut in Taenien. Zeit. f. Wissensch. Zoölogie, Leipsic, 1853, vol. 4, p. 409.

The fully developed tenia echinococcus is a small worm, measuring from 2.5 to 5 or 6 mm. in length. The head is 0.3 mm. in breadth, and it has a double row of twenty-eight to fifty little hooklets which are placed in a circular manner on the rostellum. Besides these hooklets it has four suckers which are situated below the hooklets, and are likewise placed circularly around the head. By means of these suckers and hooklets the worm keeps itself immovably fixed on the intestinal wall. The parasite consists of three or four segments, the last of which is alone matured, and is called the proglottis. This contains the eggs, within each one of which is a small embryo or oncosphere. These eggs are very numerous and in the fully developed proglottis are about 5,000 in number. The segment next to the proglottis contains the genital apparatus, which consists of the testicular vesicals, vas deferens, ovary, and vitellogene gland.

When thoroughly ripe the proglottis is cast off from the rest of the worm, and its place is taken by a new proglottis which grows out from the active portion of the parasite. The proglottis with the eggs inside of it is expelled with the feces. These eggs may remain active for a long time, even in the dry state. Dogs disseminate the eggs in numerous ways, chiefly from their habit of sniffing, during which the eggs may adhere to their noses. Persons who are too familiar with dogs may thus become infected by allowing their dogs to lick them. In agricultural districts the method of dissemination is still easier, for the dogs may contaminate vegetables which, if eaten in the raw state, may easily be the carriers of infection. Drinking water contaminated in this way is supposed to have caused the disease in a number of instances.

When the egg reaches the stomach of the human being its enveloping membrane is dissolved by the action of the gastric juice. If many of the eggs have been ingested it is undoubtedly true that many of the embryos must perish,

otherwise multiple echinococcus cyst would be very much more common than it really is; as a matter of fact, multiple echinococcus cyst is exceedingly rare in man. If the freed embryo survives, it immediately, by means of six little hooks or spicules, which it carries on one of its hemispheres, clings to the coat of the stomach or intestine, as the case may be, and by means of movements of these little hooks burrows into the tissues and gets into the circulation. When once in the circulation it is carried to different parts of the body. As the larger part of the blood current goes to the liver, this being the largest organ in the abdomen, we find that echinococcus disease is much commoner in the liver than it is anywhere else in the body, and it is estimated that fifty to sixty-nine per cent. of the cases occur here. Lyon[1] found, in an analysis of two hundred and eighty-seven organs in two hundred and forty-one cases, the liver affected one hundred and seventy-seven times, or seventy-three per cent. These statistics were compiled from cases occurring in the United States and Canada. If the oncosphere gets into the circulation through the lymphatic system it is carried first to the heart, and in rare instances remains there, and causes the disease in the heart itself; but usually it is carried to the lungs, and if it does not remain here, passes through the capillary network in the lungs, returns to the heart again, and gets into the system.

The kidney is affected in about one per cent. of the cases, accoridng to Finsen[2], who examined two hundred and fifty-five cases of the disease, and found only three, or 1.17 per cent., in which the kidney was affected; it is interesting to observe that in these two hundred and fifty-five cases, the disease began in some organ in the abdominal cavity, in ninety-two per cent. of the cases. Thomas[3] collected reports of three hundred and seven cases occurring in Australia between the years 1868 and 1877. Among these there were only

[1]Am. Jour. Med. Sci., 1902, n.s., vol. 123, p. 135.
[2]Arch. Gén. de Méd., 1869, vol. 1, p. 29.
[3]Lancet, London, 1879, vol. 1, p. 297.

two cases, or .065 per cent., in which the kidney was affected. Morris[1], collecting the figures of the various observers, got together 2111 cases, and among these the kidney was affected one hundred and fifteen times, or 5.44 per cent. Gardner,[2] who had a large personal experience in treating hydatid disease, is inclined to believe that the number of kidney cases must be very small. He makes the comment that the large percentages given by other observers must be due to the fact that their lists were compiled, not from personal experience, but from published reports of others. These results must be misleading, for, owing to the comparative frequency of echinococcus of the liver and lungs, many cases must have passed unpublished, whereas it is probable that the renal cases, on account of their rarity, have been more commonly recorded.

Gardner's opinion is confirmed by the figures of Cranwell and Vegas,[3] who, in a list of 1696 cases of hydatid disease occurring in Buenos Ayres, found the kidney affected only 36 times, or .021 per cent.

When the oncosphere is finally arrested, it immediately begins to undergo the perculiar transformations which result in the formation of a hydatid cyst. The spicules which surround the oncosphere first disappear, and this is followed by the formation of a tiny cyst, which contains a clear, colorless liquid. Nothing further occurs until the cyst is about five months old; at this time it measures from 15 to 20 mm. in diameter. The cyst now is made up of two layers: the external layer, which is a fibrous investment, and an internal or germinal layer. The former serves merely as a protecting membrane, while the latter is the seat of origin of the so-called brood capsules, which now begin to appear. Outside of the external layer there is inflammatory reaction in the tissues, and this results in the forma-

[1] Surg. Dis. Kidney and Ureter, London, 1901, vol. 1, p. 670.
[2] Intercol. Quart. of Med. and Surg., Melbourne, 1894–1895, vol. 1, p. 147.
[3] Revista de la Sociedad Medica Argentina, 1904, vol. 12, p. 215.

tion of a dense fibrous tissue envelope, which is sometimes called the ectocyst, or adventitia (Fig. 43). In consequence of the very gradual increase in the size of the cyst, the organ which is attacked has an opportunity to undergo vicarious hypertrophy; the result is that no special symptoms are produced, and in many cases the disease remains unrecognized for a number of years.

The brood capsules consist of tiny vesicles about the size of a poppy seed, which cling to the side of the germinal

Fig. 43.—Colony occupying the Sinus of the kidney. The kidney is seen flattened out on the surface of the cyst. From J. Bland-Sutton; Tumors, Innocent and Malignant, London, 1907, page 656.

membrane by means of a small pedicle. They are detached with ease, and then float about in the liquid. Each capsule consists of a delicate enclosing membrane, and inside of it there is a clear fluid. The walls of these capsules are made up of thin layers of plasmodium, but the order of the layers is just the reverse to what it is in the parent cyst, or mother cyst, as it is called; inside of the brood capsule is a thin cuticle, while on the outside is the parenchymatous

layer. Clinging to the walls of the inside of the brood capsule by means of a tiny, narrow pedicle, are little dark, ovoid bodies, the so-called scolices or larvae, which may number from 1, 5, 10, 50, or even as many as 100 or 120, in a single capsule; they are barely microscopic in size, and appear as specks. Braun[1] states that the scolex may form either externally or internally to the brood capsule. When fully developed the scolex measures about .19 by .16 mm. It is provided with four sucking disks which appear on its head, and a rostellum of tiny, blunt hooklets, to the number of 32 to 40. If the brood capsule ruptures, these little scolices float about freely in the liquid of the mother cyst. The little heads of the scolices have the power of evagination within the body of the scolex, and when evaginated the scolex looks like a little ball; when in the retracted state their hooklets appear bristling and brilliant. Scolices never arise alone from the germinal layer of the mother cyst, and are always found in the interior of the brood capsule. When the vitality is lowered the hooklets are loosened from the scolices, and float about in the hydatid liquid; these little hooklets sometimes form an important diagnostic feature. A cyst which contains these little scolices is called a cephalocyst, in distinction from the sterile cysts, which are called acephalocysts. Very exceptionally a mother cyst will remain acephalic throughout its whole course, and in this event the disease is not apt to be serious. Cysts larger than the size of an egg are rarely sterile. It is always possible to recognize hydatid cysts originating from oncosphores from the laminated appearance of their walls, which is a constant feature, and diagnostic of echinococcus disease.

There is still another important part of the fully developed mother cyst. Taking origin between the strata of the cuticle of the mother cyst, arise the so-called daughter cysts, or hydatids. These are cysts exactly resembling the

[1]Animal Parasites of Man, Sambon and Theobald, N. Y., 1906, p. 253.

mother cyst in both their external and internal layers, and consequently they are covered externally by a fibrous membrane, and internally by a parenchymatous layer. In the process of their growth they may grow outside or inside the mother cyst; in the former case they are called exogenous and in the latter, endogenous daughter cysts. The exogenous form is exceedingly rare in man, and when it does occur, its principal location is in the bones. McQueen,[1] however, contrary to the prevailing opinion, believes that exogenous daughter cysts are not rare in man. The endogenous daughter cysts vary in number, and the size of the mother cyst has nothing to do with the number of daughter cysts. Occasionally a mother cyst may be crammed full with daughter cysts, and there may be thousands of them. Sterile mother cysts occasionally contain daughter cysts, but this is very exceptional. Daughter cysts are usually quite small, the size of a marble or smaller, although sometimes they are as large as an apple; many of them are not larger than a pea or a millet seed. After a time they separate themselves entirely from the parent cyst, and float about freely in the liquid.

The daughter cysts, in the same manner as the mother cyst, may form brood capsules, and likewise scolices; they may likewise, exactly as mother cysts, produce other cysts again, which are called granddaughter cysts.

The liquid contained in the mother cyst is originally formed from the blood of the host; it is limpid, and has a specific gravity of 1007 to 1015; it contains mineral salts, especially chloride of sodium, phosphates, sulphate of sodium, and succinic acid; it also contains toxic substances, the nature of which is little known, but which appear to belong to the group of ptomaines, and which are the cause of the hydatid poisoning seen in cases in which the fluid escapes into the tissues. The amount of this fluid is very variable. When the mother cyst is crammed with daughter cysts, the

[1] Parasites and Parasitic Diseases in Animals, London, 1905, p. 433.

fluid is slight in amount, but when the daughter cysts are not numerous the fluid may reach as high as three liters or more.

The foregoing describes the usual method of origin of an echinococcus cyst. But these cysts may likewise arise in another way, namely, from scolices. The suspicion that there might be a second mode of origin of an hydatid cyst was aroused by noting that multiple echinococcus cyst was sometimes seen in the peritoneal cavity of the human being affected by the disease; in these instances the symptoms and signs of rupture of the primary cyst, with escape of the contents into the peritoneal cavity, suggested that these secondary cysts might be the result of grafting.

Naunyn[1] was the first to show this, and later Lebedeff and Andrejew[2] confirmed his results by successful inoculations of the peritoneal cavity of rabbits, with echinococcus fluid taken from man. The same experiments were successfully performed by Alexinski[3] and Riesmann,[4] who isolated scolices, and inoculated them into animals.

Dévé[5] examined a small secondary hydatid cyst found in the peritoneal cavity of a female during the course of a laparotomy. Serial sections were made, and in the cyst were found daughter cysts and brood capsules, each of which contained two or three scolices, *which as yet had no hooklets*. In the germinal layer of the secondary cyst, in one little area, was found a collection of *mature adult hooklets* to the number of 18 or 20, in a little heap, evidently the remains of the original scolex. This seems conclusive proof of the origin of a cyst from a scolex, and shows that the process is one of progressive evolution.

Dévé[6] describes the method of growth from a scolex in the following manner:

[1]Arch. f. Anat., Phys., und Wissench. Med., Leipsic, 1862, p. 629.
[2]Virch. Arch., 1889, vol. 118, p. 552.
[3]Khirurgia, Mosk., 1897 vol. 1, p. 289 and ibid. 1893, vol. 3, p. 17.
[4]Beitr. klin. Chir., 1899, vol. 24, p. 223.
[5]Compt. Rend. Hebd., Soc. de Biol., Paris, 1902, vol. 54, p. 84.
[6]Compt. Rend. Hebd., Soc. de Biol., Paris, 1901, vol. 53, p. 299.

"The scolex increases in size, its tissue becomes loosened and is transformed into a light network, the meshes of which stretch from the base of the rostrum to the deep surface of the cuticle. This network, which serves to support the numerous small granulations and the chitinous plates, becomes more and more stretched, and tends to disappear. Granulations collect in the periphery of the vesicular scolex, and later constitute the granular layer which lines the internal surface of the cuticle; at the time that the central network disappears, the hooklets gather together in a heap in the middle of an islet of small granulations and are pushed toward the periphery, and finally, in the thickness of the granular layer are found as remains in the cyst."

The after history of a cyst developed from a scolex is precisely the same as that of the usual form.

This method of origin of cysts from scolices has an important clinical interest. During the course of an operation for removal of an echinococcus cyst which is filled with scolices and brood capsules, it is easy to see how new cysts might be formed by allowing the scolices to escape into the surrounding tissues.

Besides the form of echinococcus cyst which has just been described, there is another variety which is called *echinococcus multilocularis*. In this form of the disease a tumor may arise, which varies in size from that of a fist to a child's or even an adult's head. This form is very rare in man, but is more common in animals. In man the liver is the organ almost invariably affected. It is exceedingly rare in the United States, and Osler[1] has been able to find but six cases in this part of the world. It appears to be common in certain countries. Thus, Peiper[2] calls attention to the fact that it is frequently seen in certain parts of Switzerland, Bavaria, Austria, and Russia, and that it is

[1] Principles and Practice of Medicine, 1905, N. Y., p. 37.
[2] Modern Clinical Medicine, Diseases of the Metabolism of the Blood, Parasites and Toxicology, Salinger (Cabot), N. Y., 1906, p. 528.

worthy of note that in the classical countries in which the usual form is common, such as Iceland, Australia, and Argentine Republic, the echinococcus multilocularis either does not occur at all, or it has been very rarely observed.

The growth takes the form of a large number of small cysts embedded in a connective tissue stroma, each cyst measuring between 1, 3, 4, and 5 mm. in diameter. On section, the mass has a honeycomb appearance. The contents of these little cysts is sometimes a transparent fluid within which the scolices and brood capsules are found, but in contradistinction to the usual form of hydatid cyst, scolices are rare, and even when found, are never in such large numbers as in the common form. Sometimes the cyst contains an opaque, colloid looking mass which appears to consist of collapsed walls of the vesicles, which have doubled on themselves. Globules of fat, pigment, fat crystals, and hematoidin, are sometimes found in the cyst, and when this occurs the fluid is opaque. Intercommunication between the cysts is not uncommon.

A peculiarity of echinococcus multilocularis in man is that disintegration is apt to set in at a certain stage. Suppuration supervenes, and in the center of the mass a cavity forms, which is filled with purulent fluid in which remains of the separate parts of the cyst, such as scolices, hooklets, etc., may be found. It is this disintegration which makes the disease so very fatal.

The nature of this form of the disease is quite obscure. There is some ground for believing that the disease is the same as that seen in the more common form of hydatid, and that the peculiar morphologic characters are due to unusual proliferation of exogenous daughter cysts. A striking analogy to the echinococcus multilocularis is seen in the exogenous proliferation which is a feature of the echinococcus disease when it affects the bones. On the other hand, Dévé[1] and others call attention to the following points as evi-

[1]Compt. Rend. Hebd. Soc. de Biol., Paris, 1903, vol. 55, p. 1370.

dences of a different nature: (1) the strikingly different geographic distribution of the multilocular form; (2) its tendency to central necrosis; (3) its great difference morphologically. Experimental research in an endeavor to prove this different character has not as yet resulted in anything definite. Mangold,[1] however, fed a young pig with oncospheres of the tenia reared from multilocular echinococcus; two months later echinococcus multilocularis was found in the liver. This is the only observation bearing on the point that seems to possess any positive value, and it is possible that it may have been merely a coincidence. Further experiment is needed.

The cycle of evolution of the tenia will now be easily understood. The tenia in the dog casts off its proglottis containing numerous eggs; this proglottis is expelled with the fecal matter of the dog, undergoes disintegration, and the eggs which it contains are disseminated on the soil, or in the grasses and vegetables of pasture land. The animals which graze upon this soil eat the eggs, and these get into the stomach; the gastric juice dissolves the external layer of the egg, and liberates the oncosphere, or embryo; the embryo gets into the circulation by means of movements of its hooks, and is carried to different parts of the body; there it undergoes its cystic evolution, and is transformed into an echinococcus vesicle; the animal which carries these cysts is slaughtered; its viscera are eaten by the dog, and the scolices or larvae contained in the brood capsule find themselves once more in the stomach of the dog; the scolex is soon set free by the solution of the external capsule under the influence of the gastric juice, and the scolex or head of the coming tenia fixes itself by means of its suckers and hooklets into the intestinal tract and begins to grow; it reaches its maturity in about six or eight weeks, and immediately begins to go through the same evolution again.

[1]Berlin klin. Woch., 1892, vol. 29, p. 54.

The disease is transmitted to man principally by means of the dogs themselves, as has already been described.

ETIOLOGY

Echinococcus disease is especially common in certain countries. Iceland is particularly infested, and it has been estimated that at least one-sixth of the population have hydatids. Australia and the Argentine Republic are also noted for the prevalance of this disease. It is also endemic in certain parts of Europe, and seems to be especially prevalent in certain countries. Germany, Austria, and France, as well as Russia, have contributed many cases. It is less common in England and Ireland, but in France there have been many instances of the disease. It is quite rare in the United States and Canada, and Lyon[1] could find but two hundred and forty-one cases in literature on the subject.

It has been noticeably evident to all observers that the prevalence of the disease, especially in Iceland, is more marked in localities in which there are numerous dogs. The intimate relations that sometimes exist between dogs and man act as a decided etiologic factor in the spread of the disease. The Icelanders live with their dogs, and frequently use the same utensils in common.

The age at which echinococcus disease is most likely to occur is between twenty and fifty years. Lyon's[1] table with reference to this point is interesting. In two hundred and forty-one cases the age was mentioned one hundred and thirty-five times, as follows:

0	-	9	1
10	-	19	7
20	-	29	35
30	-	39	45
40	-	49	21
50	-	59	16
60	-	69	5
70	-	79	3
80	-	89	2
			135

[1]Am. Jour. Med. Sci., 1902, n.s., vol. 123, p. 131.

According to this table about seventy-four per cent. of the cases occurred between the ages of twenty and fifty, and fifty-nine per cent. of the cases between the ages of twenty and forty.

Finsen[1] found practically the same results with reference to age. Twenty-six per cent. of his cases occurred between the ages of twenty and thirty.

The disease is exceedingly rare under the age of fifteen, and Nicaise[2] was able to find but twenty cases between the period of birth and the age of fifteen. This is remarkable in view of the usually intimate relations that exist between children and animals.

Finsen,[3] in an analysis of two hundred and fifty-five cases of echinococcus affecting the organs of the body, found the disease affecting one hundred and eighty-one females and seventy-four males. These figures do not coincide with those of other recorded observations. Renal hydatid, according to Roberts,[4] is much more common in men than in women. In Roberts' sixty-three cases there were forty-one men and twenty-two women. In Boeckel's[5] twenty cases of hydatid of the kidney there were eleven women and nine men. Roscher[6] in a list of ninety-seven cases found fifty-five males and forty-two females. While Nicaise[7] in a list of forty-seven operative cases found thirty-five females and twelve males.

It is difficult to reconcile the disparity which exists between these figures.

Trauma is mentioned by Kirmissen[8] as an etiologic factor in the causation of the disease, and he mentions three cases in which trauma of the liver, arm, and calf of the leg

[1] Arch. Gén. de Méd., 1869, vol. 1, p. 35.
[2] Th. de Paris, 1905, p. 24.
[3] Loc. cit., p. 35.
[4] Urinary and Renal Dis., Phil., 1885, p. 572.
[5] Étude sur les Kystes Hydatiques du Rein Paris, 1887, p. 63.
[6] Ueber die Echinococcuscysten der Niere und des Perirenalen Gewebes, I.D., Freiberg, 1898, p. 15.
[7] Th. de Paris, 1905, p. 4.
[8] Arch. Gén. de Méd., 1883, vol. 2, p. 516.

was followed by the development of hydatid disease in these regions. This view seems not unreasonable, considering the influence that trauma is supposed to have on the development of certain other diseases of the kidney, notably tuberculosis, and it is possible that it may have some weight.

Roberts[1] in forty-two cases of hydatid of the kidney, found the left kidney affected twenty-two times, and the right eighteen, while both organs were affected at the same time only twice. Nicaise[2] in an analysis of three hundred and fifty-seven cases found that there was no difference as to side in this respect, the right being affected just as often as the left.

PATHOLOGY

Very exceptionally the disease starts in the perirenal tissues, and in the process of growth the tumor compresses the kidney and interferes with its function. These cases are exceedingly rare. Occasionally the disease starts underneath the capsule of the kidney, and does not involve the kidney substance at all, at least not for a long while; ultimately, however, the kidney is involved in the process of growth. The usual seat of origin is in one of the poles of the kidney, and in these cases the remaining kidney substance usually remains healthy; there is no special predominance of the disease in either pole. The convex border of the kidney is quite frequently primarily attacked, and in these cases the kidney is dislodged from its normal position; this type is especially apt to extend to the pelvis of the kidney, and rupture of the cyst into the pelvis is not uncommon. When the cyst is a large one it may cause flattening of the renal parenchyma, into which it grows, and this flattening is seen as a thin coating of kidney tissue which surrounds the outside of the cyst; the kidney thus forms a part of the wall of the cyst. Very small cysts are sometimes included

[1]Urinary and Renal Dis., Phil., 1885, p. 561.
[2]Th. de Paris, 1905, p. 36.

within the renal parenchyma. The presence of two cysts in one kidney is of exceptional rarity. Single cysts are young ones, while the cysts containing daughter cysts are those which have had an opportunity to develop.

The oncosphere is arrested in the vicinity of the convoluted tubles, the blood vessels in this part of the kidney being exceedingly small; it is probable, therefore, that most of the cysts, when they affect the renal parenchyma, arise in this locality. Very exceptionally the disease arises in the neighborhood of the hilus of the kidney; this location is exceedingly dangerous from an operative point of view, and usually means that the kidney will have to be removed with the cyst.

The disease has been known to arise in a single kidney. Nicaise,[1] in his list of three hundred and fifty-seven cases, found this occurring four times.

The occurrence of hydatid disease elsewhere in the body at the same time with renal echinococcus is very excepitonal. Nicaise[2] in his list found thirty-seven cases of multiple echinococcus.

The size of the cyst varies greatly. At first the disease is slow in its course, and the cyst remains small for a considerable length of time. When it begins to grow the increase may be very rapid, and at the end of eighteen months or two years the cyst is of appreciable size. The usual volume of the tumor in most cases equals that of a fetal head, and sometimes of an adult head. Many of the tumors are small, and do not exceed the size of an orange or of a fist, while the large ones, when they begin to grow, rapidly increase in size, and may even half fill the abdomen.

Large cysts are particularly apt to contract adhesions with neighboring organs. These adhesions may be very dense, and when extensive constitute a serious difficulty at operation.

[1] Loc. cit., p. 35.
[2] Loc. cit., p. 39.

The cyst may rupture in various directions. It has been stated by a number of observers that perforation through the lumbar region is possible. This seems doubtful, and it is possible that cases in which perforation has occurred in the lumbar region have been hydatid of the lumbar muscles, rather than of the kidney. Perforation into the pelvis of the kidney is quite common. When the cyst ruptures into neighboring organs, like the stomach or bowel, the fluid contents in these organs penetrate the cyst and cause the death of the parasite. Suppuration is now very apt to occur, and the cyst which before was comparatively harmless becomes actively dangerous. Suppuration without perforation may occur, but it is rare. Should a condition of pyelonephritis supervene, interference may be urgently demanded. Rupture into the peritoneal cavity is exceedingly rare, and this is remarkable in view of the fact that blows on the abdomen are of comparative frequency.

The cyst may remain active and alive for many years, and may not during this time occasion any marked degree of suffering. Cysts have been known to exist for twenty and even thirty years, the patient meanwhile enjoying fair health. Occasionally the cyst dies, and then the process comes to an end by gradual inspissation of the contents, and the conversion of the cyst into a mass containing putty-like, or granular material, which may be partially calcified. The cyst is now harmless and may be carried during the rest of life. As it gets older it gets smaller, and assumes a friable appearance.

The inflammatory reaction which always occurs around the mother cyst leads to the formation of the adventitia, or ectocyst, as it is called. This adventitia is of great importance from a surgical standpoint. Fibrous tissue is formed from 2 to 8 mm. in thickness, or even more, and cartilaginous or calcareous change is not uncommon, especially if the disease is well advanced. The inner surface may be smooth or mammillated, or irregular and shriveled. Inasmuch as

the ectocyst is formed from the kidney substance there is no line of cleavage, and it cannot be separated from the kidney itself without tearing the healthy renal tissue. The ectocyst exercises a continuous pressure on the surrounding parenchyma, and this pressure leads to gradual atrophy and disappearance of the normal tissue. If the process is long continued, and the cyst of large size, the kidney may even entirely disappear.

SYMPTOMS

Hydatid of the kidney gives rise to few symptoms in the first part of its course. The slowly growing tumor displaces the organs about it so gradually, and the changes in the kidney itself are so benign, being, in fact, nothing more than a gradually progressive atrophy, that symptoms are usually entirely absent at first. The disease is frequently discovered by accident, and in many cases the first indication of the trouble is an unexplained tumor which is discovered under the ribs. This condition may persist for years, and nothing further occurs until perhaps a sudden attack of severe pain in the kidney region, which is due to the bursting of the cyst into the renal pelvis, and the discharge of the hydatids along the course of the ureter. In rare instances recovery may now take place, but usually the disease goes on, the perforation closes, the cyst fills up again, and after an interval, the same train of symptoms happens once more. If suppuration supervenes, the clinical aspect changes to that of suppurative nephritis, and if interference is not allowed, the patient gradually becomes emaciated, and dies from marasmus and exhaustion, possibly with complicating disease.

Pain in the lumbar region is sometimes quite a prominent symptom of hydatid disease of the kidney. The pain is usually not severe, and is rather a feeling of weight and uneasiness. If long continued, it is apt to be accompanied by digestive disturbances. Later on in the course of the dis-

infrequent, and Nicaise[1] was able to find but twenty-five instances of suppuration in one hundred and thirty-four cases in which rupture had taken place.

The frequency with which rupture into the pelvis of the kidney occurs is shown by Nicaise.[2] In a list of one hundred and sixty-one cases, rupture into the pelvis occurred one hundred and four times. Houzel[3] records thirty cases out of thirty-nine in which this rupture occurred. Roberts[4] in an analysis of sixty-three cases found perforation of the pelvis of the kidney forty-seven times; of the pelvis of the kidney and lungs, once; of the kidney and intestines, three times; of the pelvis of the kidney and the stomach, once; of the lung alone, once; while eight times the cyst did not open, and twice it was opened artificially.

Perforation into the peritoneal cavity is extremely rare. It almost never occurs by itself, and is usually due to a blow received in the region of the tumor. Acute general peritonitis may be the immediate result, and this is followed by rapid death. Should death not immediately occur, toxic symptoms, which are thought to be due to the action of the ptomaines in the hydatid fluid, may be observed. In severe forms there may be epileptoid fits, which are sometimes fatal; and in milder cases, urticaria accompanied by severe itching, lasting two or three days, and sometimes attended by high fever, may be observed. A low grade of peritonitis sometimes follows rupture into the peritoneum, with the formation of a fluid of pea-soup-like consistence.[5] A most unfavorable ending to rupture into the peritoneum is the formation of multiple secondary cysts, the origin of these cysts being due to the scolices which have been discharged with the fluid. Such a condition of multiple cysts renders ultimate cure very doubtful, on account of the dif-

[1]Loc. cit., p. 42.
[2]Loc. cit., p. 36.
[3]Revue de Chir., 1898, vol. 18, p. 703.
[4]Urinary and Renal Dis., Phil., 1885, p. 562.
[5]See Imlach, Brit. Med. Jour., 1887, vol. 2, p. 17.

ficulty of finding the cysts at operation, for, if small, they readily escape observation, as they are scattered about among the bowels, and it is almost impossible to find all of them. Repeated operations have been done in cases of this kind. Rupture of a renal hydatid into neighboring organs is possible, but it is not of frequent occurrence. Rupture into the stomach has occurred a number of times, and likewise into the intestinal tract. These are very unfavorable complications, because the cyst is sure to be contaminated by the contents of the stomach or intestines, and suppuration must follow. Rupture into the lungs is likewise a serious complication, and when this occurs the diagnosis is at once made evident by the coughing up of hydatids. Death is the almost invariable result.

The hydatid tumor in the early stages of the process has a globular outline, and careful palpation will sometimes discover the kidney behind it. It usually presents in the direction of the abdomen, and in well advanced cases may extend as far as the median line, or even beyond it. If not large it can frequently be moved slightly in a lateral direction, and if the disease occurs in a floating kidney, as it sometimes does, the mass can of course be easily slipped between the examining hands. The tumor almost never follows the movements of respiration. Its relations with the intestines are, in the main the same as in the case of other tumors of the kidney. The colon is usually found in front of it, but in some instances the cyst is found either to the inside or outside of the bowel. Large cysts, however, frequently have relations to the intestines like those of other abdominal tumors, notably cysts of the ovary, and it is often almost impossible to differentiate them. A dull note is given on percussion, except in the place where the bowel presents. If the tumor is of very large size, gastric symptoms may be pronounced, and there may be considerable oppression in breathing.

Fluctuation is sometimes obtained, but in cases in which

the cyst is filled with daughter cysts this symptom will be absent. Very tense cysts likewise will not give fluctuation, and these cysts resemble in their physical character solid growths of the kidney, and can with difficulty be differentiated from them.

Hydatid fremitus, when found, is absolutely diagnostic of the condition, but unfortunately it is not often found. Houzel[1] in thirty cases of renal hydatids found the fremitus in two only, while Boeckel[2] found it only once in twenty-one cases. The sign can be compared to the sensation given by the striking of a repeater watch held in the hand. There is no uniformity of opinion as to the cause of this sign. It is most frequently met with in large cysts with thickened adventitia containing a moderate number of daughter cysts. It is never present when the cyst is suppurating, for so thick a fluid as pus prevents the oscillations being felt. The presence of the daughter cysts can probably have nothing to do with the sign, because slight fremitus has frequently been elicited from sterile cysts. To evoke the sign, one hand is placed upon the tumor, and tapped sharply with the other; a thrill will be immediately communicated to the fingers. A similar sensation is appreciated when a stethoscope is applied to the tumor, and the tumor tapped with the fingers.

The duration of the disease varies greatly. It may last for a few years and then cause death, or in mild cases it may last as many as twenty, or even thirty years, or more, the patient meanwhile being in a state of comparative health, and not being inconvenienced, except possibly by symptoms referable to pressure by the tumor upon other organs. If the kidney on the affected side undergoes atrophy and disappears, the opposite kidney, on account of the long duration of the process, has had ample time to undergo compensatory hypertrophy; hence the danger from deficient urinary secretion is almost *nil*. In rare instances a single

[1] Revue de Chir., 1898, vol. 18, p. 699.
[2] Loc. cit., p. 31.

kidney is affected, and in these cases uremic symptoms are sure to appear if the integrity of the kidney has been seriously impaired. The cause of death in neglected cases may be due to exhaustion, although this is very rare, to suppurative processes in the cyst and kidney, and to complicating diseases such as phthisis and pleurisy. In some instances death has been caused by the effects of pressure of the cyst upon neighboring organs.

Hydatid disease of the adrenal has been reported in a very small number of cases. In these cases the symptoms and signs are those of cystic disease of the adrenal, and it is practically impossible to differentiate the two.

The paranephric tissue has likewise been the seat of the disease in a few cases, and here the disease cannot be differentiated from renal hydatid.

Multilocular hydatid cyst of the kidney has never been met with, most of the cases in man occurring in the liver.

DIAGNOSIS

The diagnosis is frequently involved in great obscurity. Before rupture has taken place the tumor may well be taken for any one of the numerous symptomless growths which may be found in the abdominal cavity. In cases in which the tumor is of considerable size, the slow growth, the accidental discovery of a tumor, the absence of general symptoms, and, in countries where the disease is common, the close association with dogs, are at least suggestive of the diagnosis. In the majority of cases the diagnosis must be made entirely by exclusion. Hydatid fremitus is the only positive diagnostic sign which we possess before rupture has taken place. If this is obtained we may be fairly certain that hydatid disease is present. A solid tumor cannot be excluded if the cyst is tense. In other cases fluctuation is sometimes very obscure, and resembles the indistinct fluctuation occasionally given by lipoma and soft sarcoma. If fluctuation is obtained, the differential diagnosis is confined

to those conditions associated with the presence of fluid, such as hydronephrosis, polycystic disease, and the various large cysts affecting the abdominal contents, particularly cystic ovary. Hydatid cysts of the kidney differ from those of the liver and spleen in that in these latter organs there is immobility only at the base of the tumor. The outline as shown by percussion over the border of these organs is also of diagnostic importance. The kidney may sometimes be felt on the surface of the cyst, and this is of great diagnostic importance. The location of the tumor, whether it is intraperitoneal, or retroperitoneal, or whether it is growing from the abdominal wall, can usually be determined. Tumors attached to the abdominal wall do not tend to disappear when the abdominal muscles are contracted. Tumors behind the peritoneum usually have intestine over them, while large tumors in the peritoneal cavity are very apt to be placed directly against the abdominal wall, in which case a dull note is obtained on percussion. The relation of the colon to a hydatid kidney is the same as that in other renal affections.

The diagnosis is, of course, at once evident if hydatid cysts, scolices and hooklets are found in the urine after rupture. Here, however, we must distinguish between a renal hydatid and a cyst originating in another organ which has discharged into the urinary tract. The renal hydatid tumor at once either diminishes in size, or at least becomes much softer after a discharge. Cases of hydatids of the liver discharging through the kidney have been reported, and the differential diagnosis here is, of course, impossible.

A hydronephrosis varies in size at different periods, and when it diminishes there may be an enormous discharge of urine. A hydronephrotic sac may sometimes be emptied by means of a renal catheter. In such cases a large amount of urine which is at once collected, together with the information given by the analysis, will serve to differentiate this affection. Besides this there may be a history of some form of stricture.

Ovarian disease is eliminated by careful inquiry into the history of the case. These tumors begin from below and grow upward. Besides this, the physical character of the tumor, its relations to the intestines, and likewise the history of the case with reference to previous menstrual disturbances are significant. A hydatid in a floating kidney, however, cannot be distinguished from an ovarian cystoma.

Polycystic disease of the kidney may be very difficult to differentiate. Polycystic disease may be bilateral; it may be accompanied by hematuria, and the physical characters of the tumor are sometimes marked; but in cases of single tumor, in which there are no accompanying symptoms of polycystic disease, the differential diagnosis is well-nigh impossible.

A suppurating echinococcus cyst of the kidney, before rupture has taken place, may be mistaken for perinephric abscess, and the diagnosis may not be plain until incision is made. A hydatid cyst which has suppurated after rupture into the pelvis of the kidney may be mistaken for pyelonephritis, pyelitis, or tuberculosis.

PROGNOSIS

The danger of death from hydatids of the kidney is relatively insignificant. It occasionally happens that a spontaneous cure will result after rupture and discharge of the cysts, but we have seen that this is of rare occurrence. The general health remains good in the majority of cases, and may continue so for long periods of time. The prognosis in hydatid disease of the kidney is rather more favorable than it is in hydatids of other internal organs, for instance, the liver, because a temporary arrest results after the discharge of the cysts through the urinary tract. If some intercurrent disease does not carry the patient away, and the cyst continues to grow, secondary complications, such as suppuration of the cyst itself, either subsequent to, or before, rupture, may be the immediate cause of death. Dis-

charge of the cyst contents into the stomach or bowel is extremely unfavorable, and so likewise is the discharge into the respiratory passages.

TREATMENT

The treatment of hydatids of the kidney is usually attended with brilliant results. Operative treatment is, of course, the only one that is to be considered. The old method of puncture, with evacuation, is unequivocally to be condemned on account of the great danger of perforation of important parts, to say nothing of the risk of subsequent leakage from the cysts, which may entail secondary inflammation.

In contemplating surgical treatment of hydatid disease of the kidney, it should be borne in mind that the disease is a benign one; that much of the kidney substance is healthy, and capable of performing normal work. It should be the rule to follow closely the principles of conservative surgery, and to attempt to save as much of the kidney substance as possible, compatible with the best interests of the patient.

The ectocyst is really the most important consideration, surgically speaking, for in most cases the mother cyst can be entirely and completely excised by an experienced operator. The surgical difficulties attendant upon the treatment of the ectocyst, or adventitia, have given rise to much ingenuity and thought in the treatment of this affection.

There are four principal methods of treatment of hydatid cyst of the kidney. They are:

1. Nephrectomy.
2. Nephrostomy.
3. Resection.
4. Delbet's operation: "capitonnage."

One of the chief dangers following any operation for the treatment of these cysts is the possibility that secondary echinococcus cysts may develop from escaped scolices, which

have during operation, unavoidably perhaps, contaminated the surrounding tissues. Dévé,[1] recognizing this danger, advises, after the cyst has been exposed, to partially aspirate it, and immediately inject into it 500 ccm. of a 1:1000 corrosive sublimate solution, or a 1:100 solution of formalin; this is allowed to remain in the cyst five minutes, after which time the cyst may be emptied. Experiments[2] showed that the scolices floating about in the fluid were all destroyed by these injections.

NEPHRECTOMY

This operation should never be done unless it is plainly evident that it is impossible to save any portion of the kidney.

Nephrectomy was first performed by Boeckel.[3] It should be considered the operation of choice in those cases in which almost all of the kidney tissue has been destroyed by compression; in these cases the remnants of the renal parenchyma are flattened out over the cyst, and here it is manifestly impossible to consider anything short of a radical operation. Fortunately this class of cases is seldom encountered. A cyst which is situated entirely within the kidney, and has involved it to such an extent that resection is impossible, may also be best treated by entire removal of the organ. Under this head come particularly those cysts which are in the neighborhood of the hilus of the kidney, and which involve the renal vessels to such an extent that conservative measures are impracticable. Cysts which have suppurated and which have destroyed the kidney by pyelonephritis, especially if the condition has given rise to severe general symptoms, will likewise require nephrectomy. Cysts also which have ruptured into the lung or into the peritoneum, especially the latter, may likewise necessitate removal of the kidney. A contraindication to the operation are exceedingly dense adhesions surrounding the organ, and

[1] Compt. Rend. Soc. de Biol., Paris, 1903, vol. 55, p. 79.
[2] See Quénu, Bul. et. Mém. Soc. de Chir., Paris, 1903, vol. 29, p. 721.
[3] Kystes Hydatiques du Rein, Paris, 1887, p. 9.

in these cases it will be best to do nothing more than a neprostomy; the danger of hemorrhage during and after the operation is so great, and the mortality so high, that it is far better in these cases to be content with simple evacuation of the cyst, especially as the results of this operation are most satisfactory.

Nephrectomy has been done for hydatids of the kidney thirty-eight times.[1] In twenty-two of these cases the transperitoneal operation was done, and seven of these were fatal; in twelve others the lumbar operation was performed, with one death; the rest were not followed. The general mortality following this operation, according to Nicaise, is 21.47 per cent., as compared with a mortality of 6.12 per cent. in nephrostomy. It is evident from these figures that one should hesitate before doing a nephrectomy, and that the operation should be undertaken only in exceptional cases.

NEPHROSTOMY

This operation was first performed by Lindemann in 1871. His cases were reported by Kirchner[2] who gave an excellent account of the technique employed by Lindemann. Landau[3] improved upon the operation, and it is now done in the following manner. An incision is made over the cyst at its most prominent point, preferably extraperitoneally in the lumbar region, if possible. The tissues are cut down to the cyst; then the cyst is aspirated and enough fluid removed from it to allow the flaccid wall to be withdrawn from the abdominal cavity. This allows opening of the cyst, and evacuation without much danger of soiling the surrounding parts. Before evacuation, Dévé's injection is advised. After the cyst has been emptied by thorough flushing with water, as much of the adventitia is excised as possible, and the edges are then sutured to the edges of the skin. The operation ends by introducing a drain. If the

[1] See Nicaise, Th. de Paris, 1905, p. 46.
[2] Ein Beitr. z. Operation der Echinococcen der Organe der Bauchlöhre, I. D., Berlin, 1879, p. 7.
[3] Berlin klin. Woch., 1880, vol. 17, pp. 94 and 108.

peritoneal cavity has been opened, it is best, before incising the cyst, to suture the border of the serous membrane of the peritoneum to the edges of the skin. The after treatment consists in washing out the pocket daily with mild antiseptic solutions, preference being given to tincture of iodine solution. The mother cyst, if it has not been removed, is gradually loosened, and is discharged through the opening. If the mother cyst has been removed, the best ultimate results will be obtained by dispensing with the drain on the third or fourth day, and allowing the pocket to close as rapidly as possible. This will minimize the danger of subsequent suppuration, which is the great drawback to the operation. Infection is most likely to occur, and if it does, the fistula may remain open for weeks, or even months. Secondary hemorrhage has been known to happen after this operation, but it is usually not severe and can be controlled. Urticaria, occurring a few days after the operation, has been seen in a number of instances, but it soon subsides. There is likewise some danger from hernia, and there is also some risk that all of the daughter cysts may not have been removed, and that a recurrence of the disease may take place. This recurrence has happened in a number of instances, the secondary cyst appearing in the scar.

Houzel[1] advises Terrier's method of sewing the anterior abdominal peritoneum to the posterior peritoneum covering the cyst. After opening the peritoneal cavity, an incision is made in the posterior peritoneum outside the colon, taking great care not to open the cyst. The two peritoneal surfaces are now easily united by suture, and the result is that the general peritoneal cavity is entirely cut off. The cyst is now opened and the contents evacuated.

Nephrostomy is a comparatively benign operation. Albarran[2] collected twenty-three cases with twenty-three cures, but this table appears to be merely a collection of

[1] Revue de Chir., 1898, vol. 18, p. 824.
[2] Presse Médicale, 1901, vol. 9, p. 95.

favorable cases. Roscher,[1] in a list of twenty-nine cases treated by nephrostomy, found the result not mentioned in four, one death, and a positive cure in twenty-four. Nicaise[2] gives the mortality of nephrostomy as 6.12 per cent.

RESECTION

This operation is decidedly the one of choice when it can be performed. Unfortunately, few cases will be found in which it will be possible to do it. The two essentials are that there shall be, after excision of the cyst, two opposing renal surfaces of nearly equal extent which can be united together, and secondly, that these surfaces shall be vascular. Evidently small cysts are most suitable for this operation, and preferably cysts which have attacked one of the poles; in rare cases it will be possible to do it when the cysts occupy the middle of the kidney, but never when they are in the region of the hilus. The opening of the cyst into the pelvis is not a contraindication, for the operation has been done under these circumstances, and the after results have been excellent. A cyst which has more or less of a pedicle arrangement is very favorable, but those which have a broad attachment at the base are less so.

The lumbar incision should be selected if possible. The technique is simple. An incision is made directly into the renal parenchyma, just external to the adventitia, taking care not to leave any portion of the cyst remaining. The attempt should not be made to separate the cyst from the kidney with finger dissection. There is seldom a line of cleavage, and even when it exists it is of no great help. This procedure is rendered bloodless if the renal vessels have been previously clamped with rubber tipped clamps. After removal of the cyst the two opposing flaps of the kidney are sutured together by means of medium sized catgut sutures running through the entire parenchyma, and sutures of

[1] Ueber die Echinococcuscysten der Niere and der Perirenalen Gewebes, I. D., Freiburg, 1898, p. 134.
[2] Th. de Paris, 1905, p. 48.

finer catgut are taken between the primary sutures in order still further to close the wound. The hemorrhage following loosening of the clamp is not usually severe, and will soon stop. The operation terminates by the insertion of a drain.

This operation has been performed ten times, three times extraperitoneally, and seven times transperitoneally.[1] There were two deaths among these cases, one of which was with the lumbar incision, and the other with the transperitoneal.

DELBET'S OPERATION

This operation was devised by Delbet,[2] who first performed it for hydatids of the liver. He was led to devise the operation on account of the long duration of the secondary suppuration, which frequently followed treatment by nephrostomy. Briefly, the method consists in cutting away as much of the ectocyst as possible, after removal of the mother cyst, swabbing the walls with dry sponges, and finally sewing the opposing surfaces directly together by means of medium sized catgut, with the object of obliterating the cavity in so far as possible. The operation is ended by sewing the cut edges of the adventitia firmly together, and closing the incision without drainage. The lumbar route is to be selected if possible.

This operation cannot be performed in most cases of renal hydatids. Small cysts are most amenable to this form of treatment, but small cysts can usually be excised, a far better operation. Undue thickness of the adventitia, and the deposition of calcareous salts in the walls of the adventitia, are also unfavorable to the operation.

Nevertheless the operation has been performed twice with complete success. These cases are as follows:

CASE 1.—Lejar's[3] case of an adult female who had a large tumor in the renal region extending to the median line. An incision was made four fingers' breadths from the me-

[1] See Nicaise, Th. de Paris, 1905, p. LX.
[2] Gaz. Hebd. de Méd. et de Chir., 1896, n.s., vol. 1, p. 169.
[3] Bul. et Mém. Soc. de Chir., Paris, 1900, vol. 26, p. 485.

dian line, and the cyst was incised without opening the peritoneum. The mother cyst was removed, and as much of the ectocyst as possible was likewise excised. The ectocyst was from 5 to 8 mm. in thickness, and relatively supple; more than two-thirds of the pocket was excised, and there remained only a pocket the size of a fist, which was entirely obliterated by capitonnage. The mouth of the sac was then closed with a Lembert suture, and the abdomen was tightly closed. Recovery followed.

Case 2.—Billot's[1] case of a male twenty-three years old, with a tumor in the left lumbar region, the size of two fists. A lumbar incision was made, and the mother cyst removed. The lower pole of the kidney was involved. As much of the ectocyst as possible was resected, and the cavity washed out with Van Swieten's liquid. The cyst was then treated by capitonnage, and the opening was closed with a purse-string suture. A large silk suture was then passed into the stump, and out through the wound in such a manner as to raise the kidney as high as possible. The incision was then closed without drainage. Healing was by first intention.

The choice of the preceding methods must be determined at the time of operation. It frequently happens that a diagnosis has not been made previous to the incision, and in such cases a nephrostomy will, with rare exceptions, be selected. It also happens that even when the incision has been made it is difficult to say just from what organ the cyst arises. As landmarks are recognized this obscurity will disappear. It may perhaps then be impossible to select a method which one would have adopted had the diagnosis been evident from the start. The best method under the circumstances, therefore, is the one which will have to be selected.

[1] Congr. Internat. de Méd., Sec. de Méd. et de Chir. Mil., 1900, vol. 13, pp. 47-49.

CHAPTER XI.

DETERMINATION OF RENAL EFFICIENCY

Operation on a kidney should never be done unless it is certain that the opposite[1] kidney is capable of performing the work of the two kidneys together.

The general symptoms of renal failure are sometimes so evident as to make it certain that the opposite kidney is the site of serious nephritis, possibly secondary to the disease in the kidney affected by the disease. Again, the opposite kidney may be affected by some other surgical lesion, for instance, stone, tuberculosis, or hydronephrosis. It is therefore the duty of the surgeon to see that the opposite kidney is sound.

The general symptoms of renal failure, once started, are so pronounced that there is no difficulty in recognizing them and in interpreting their meaning.

The examination of the urine will throw much light in cases of this sort, and such an examination will at once contraindicate the proposed nephrectomy.

Edema of the extremities and of the face, hypertrophy of the heart, and calcareous arteries, are signs which should be looked for. A harsh, dry skin which does not perspire is also an important sign. General symptoms are thirst, anorexia, nausea and vomiting, severe headaches, vertigo and hiccough. The last is a symptom of great significance when it is persistent and it is sometimes the first to appear.

With the above symptomatology there can of course be no question of nephrectomy.

More obscure are those cases in which the opposite kidney harbors a disease which has not been recognized. In

[1]By "opposite" in what follows is meant the kidney unaffected by the disease.

these instances the two damaged kidneys together are capable of performing enough work so that the waste products of metabolism are gotten rid of; but neither, alone, could perform the whole work. Operation in these cases are necessarily fatal.

Physical examination of the opposite kidney will sometimes reveal a great deal. Tenderness on pressure and resistance of the muscles are important signs and should have due weight. With these signs, a previous history of pain will usually be elicited, although pain may have been entirely absent even with a kidney badly damaged.

An enlarged kidney should always excite suspicion, but it should be remembered that such enlargement may be due to compensatory hypertrophy. Some confusion may arise if such an hypertrophied kidney is painful, as it often is. This pain has been mistaken for "referred pain," due to disease on the other side. In the writer's experience "referred pain" should be looked upon with suspicion.

Further confusion may also rise in case the hypertrophied organ has been secondarily attacked by some disease. Some years ago, before the methods of estimating the renal function were in vogue, the writer had a fatal case which illustrated this point. The patient was a young girl, 22 years of age, who had suffered from pain in the right side for some time. The *left* kidney was found to be tuberculous, for purulent urine containing tubercle bacilli was drawn from the left ureter. The right ureteral urine was of low specific gravity. The right kidney was much enlarged and this enlargement was thought to be due to compensatory hypertrophy. The left kidney was removed, and on examining it the lesions were most prominent about the pelvis. It was remarked at the time of operation that the kidney seemed unusually large. The patient died at the end of five days, having passed little urine during that time. At the autopsy the right kidney was found to be much enlarged and to consist of a number of pockets containing semifluid

matter; there was little normal kidney tissue left. The condition was thought to have been due to stricture of the ureter, but as only a partial autopsy was allowed this could not be ascertained. It was evident that the right-sided lesion had been the first one and that the left kidney had become hypertrophied following disease on the right side; later, tuberculosis had attacked the hypertrophied kidney. The low urea amount on the right side was thought to have been due to temporary polyuria of the nervous class.

Since the advent of the X-ray, diagnosis of renal disease has been much simplified. We can usually, with a good apparatus, detect a stone in any part of the urinary tract. We should, therefore, not neglect this valuable aid, especially in those cases in which there is reason to suspect that a stone may be present.

Much valuable information may be obtained by the study of the ureteric orifice. Fenwick,[1] in his valuable monograph on this subject, has added greatly to our knowledge.

Murky urine loaded with shreds proceeding from a ureteric orifice, around which may be numerous ulcers and erosions, at once calls attention to a diseased kidney above. A pyonephrosis is sometimes evidenced by the expulsion of a long cheesy worm of pus from the ureteric orifice, and this phenomenon may be observed even in a case in which there has been no pain in the kidney above.

Fenwick[2] gives the following appearances of the orifice with stone in the renal pelvis.

"Dilatation of the renal pelvis by a calculus obstructing the outlet is sometimes accompanied by an apparent elongation of the corresponding ureteric orifice and by a congestion of its lips. (Fig. 44).

"Calculous pyelitis of the alkaline type produces a characteristic scald-like erosion and blush of the ureteric

[1]Ureteric Meatoscopy in Obscure Diseases of the Kidney, 1903.

[2]Ureteric Meatoscopy in in Obscure diseases of the Kidney 1903, p. 122.

fice, a condition which may subsequently give place to cicatrical warping of the opening.

"Entire cessation of the life of a kidney affected by a

Fig. 44.—Dilatation of the Renal Pelvis due to Renal Stone producing an apparent elongation in the ureteric Orifice by causing venous congestion of the Lips. From Fenwick: Ureteric Meatoscopy in Obscure Diseases of the Kidney. London, 1903, p. 122.

Fig. 45.—A large "golf hole" orifice in advanced destruction of the Kidney, such as exists in Renal Calculus and Tuberculosis. From Fenwick: Ureteric Meatoscopy in Obscure Diseases of the Kidney. London, 1903, p. 161.

calculous pyelitis is marked by a 'holing' of the orifice (Fig. 45) and a ureteric efflux of solid or semisolid pus.

"A stone in the ureter descending towards the bladder

may cause petchial hemorrhages around the opening.

"Edema about the orifice may be marked when the stone has entered the last part of the ureter.

"There is sometimes protrusion and eversion of the mucous membrane of the ureter with stones permanently arrested in some part of the lower end of the ureter. In some of these cases the mucous membrane is covered with a low growth of villous processes, either in the form of a tuft or as a continuous ring."

Fenwick states that the above appearances may be seen in conditions referred to, but he is free to say that these appearances are not always seen.

In renal tuberculosis, in cases in which the kidney is markedly diseased, there is often a "holing" of the opening, and so characteristic is this change that it is strongly indicative of serious lesion above. The size of the hole varies. Usually the edge is of a whitish color and often smooth. The opening is not always in its usual place and is frequently displaced a little to the edge of the bar. In some instances the opening is displaced upwards to quite a marked degree. Occasionally the orifice corresponding to the tuberculous kidney, instead of being an inch or an inch and a half from its fellow and the same distance from the urethral orifice, is seen to be as much as two inches from either opening.

In some cases of primary renal tuberculosis there is sometimes, according to Fenwick,[1] an enormous swelling due to edema of the lips of the ureteric orifice. Fenwick believes that it may be an early stage of the periureteritis which sometimes accompanies this disease. The changes just described are frequently seen in tuberculosis, but they are not always present and are therefore not absolutely pathognomonic of the disease.

Some information may be obtained by studying the rate of flow of the urine and likewise the movements of the ure-

[1] Ureteric Meatoscopy in Obscure Diseases of the Kidney, London, 1903, p. 183.

teric orifice. When the upper end of the ureter is blocked a feeble contraction may be observed at long intervals; no urine escapes with it.

Not only in lesions in which there is a known pathologic condition is this peculiarity observed, but it may likewise be seen in conditions in which there is no gross lesion. The writer has in two cases of nephralgia observed, on the affected side, feeble jets, at long intervals, with impaired movements of the orifice.

METHODS OF SEPARATING THE URINES

Some information may be obtained in regard to the working capacity of the two kidneys by examining the separated urines. In order to do this two methods are avail-

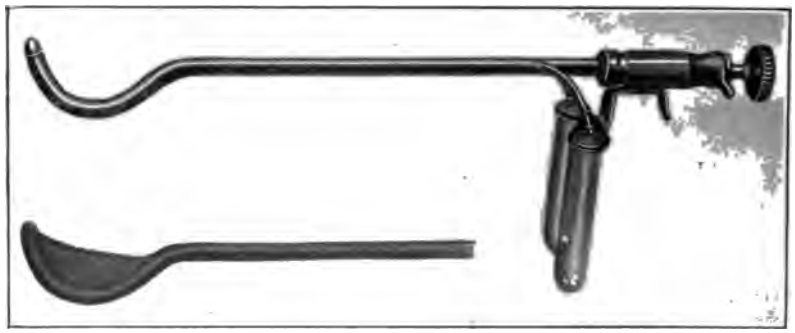


Fig. 46.—Luys Instrument, showing the Instrument ready to introduce into the bladder. The two collecting tubes near the handle are removable.
Fig. 47.—Luys Instrument, showing Rubber Membrane drawn up taut.

able: the first is by the use of an intravesical separator; the second is by catheterization of the ureters by means of one of the catheterizing cystoscopes.

The best intravesical separator, in the writer's opinion, is that of Luys (Figs. 46, 47, 48, 49, 50).

The technique of introduction is simple. The rubber membrane of the instrument is drawn over the stem and the two side catheters are fitted on the instrument (Figs. 48, 49, 50). The patient is placed in the dorsal position with the body inclined to such an extent that the shoulders are

raised about 18 inches. This may easily be accomplished by means of pillows. The bladder is washed out with boric acid solution until the fluid returns clear. The bladder is then emptied. The bladder and urethra are then cocainized with a five per cent. solution of the drug and this is allowed to remain about five minutes. The solution is then washed

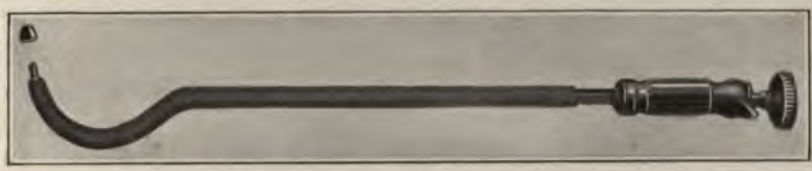
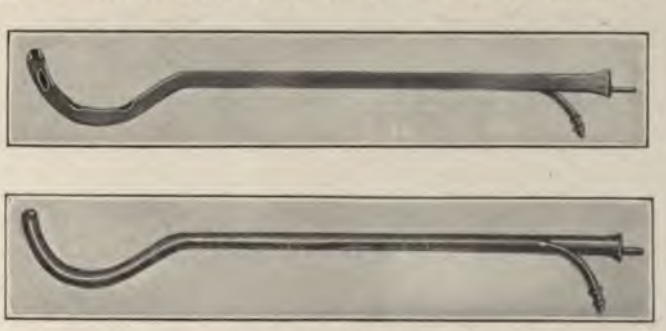


Fig. 48.—Luys Instrument, showing the Rubber Sheath drawn over the shaft.

out with boric acid. About six ounces of the boric acid are now left in the bladder. If the instrument is to be introduced into a female bladder lubrication is not necessary; but in the male it is best to lubricate the shaft with glycerin. The instrument is then introduced exactly as a sound is introduced, and when it enters into the fluid



Figs. 49–50.—Luys Instrument, with side pieces for collecting the Urine as it comes from Ureteric Orifices.

the latter passes out through the catheters. While it is flowing away the membrane should be drawn up into position by means of the screw at the handle of the instrument, doing this very quickly so that before the last drops of fluid escape the membrane is taut (Fig. 47); if the membrane is screwed up quickly enough no trauma will be caused by the tip of the

instrument. Gentle traction is now made towards the examiner and the instrument is held exactly in the median line, in the female with the handle slightly depressed, in the male with the handle slightly elevated. The bladder is again washed out with boric acid solution, allowing the fluid to enter through one catheter and pass out through the other. When the fluid has drained away an examination should be made by rectum in the male and by vagina in the female to see if the instrument is in position. The urine will almost immediately begin to flow. The first drop should be discarded. The instrument may, if needed, be left in for even an hour. In most cases, however,enough urine will have been collected in twenty minutes to allow of a satisfactory examination. It is needless to say that the preliminary cystoscopy is necessary before using Luys separator. Intravesical growths will thus be eliminated and other diseased conditions giving rise to hemorrhage. If the bladder is badly diseased, the instrument of course cannot be used. Abnormal position of the orifice on one side is also a bar, but as this occurs but seldom, it is not a serious objection.

Catheterization of the ureters is a simple matter if one has had some experience. It is an operation which does not require a general anaesthetic except in rare cases of extremely irritable bladder.

The patient is placed in the dorsal position with the buttocks slightly raised and the feet resting on stirrups. The examiner is seated in front of the patient, facing the perineum. Should an examining table be not available the patient may recline on a hard table with the lower limbs extended. If this position is used the examiner stands to the right of the patient.

The bladder is now washed out with a two per cent. solution of boric acid until the fluid, held up in a glass before the light, returns clear.

The urethra and bladder are now cocainized. For this purpose a four to twenty per cent. solution of the drug is

used. Much has been said about the poisonous effect of this drug, but in an extensive experience with it the writer has seen but one bad effect following its use, and that was in an hysteric female. This experience corresponds with that of Fenwick,[1] who had at the time his book was written used it for five years continuously in the strengths above mentioned.

The best way to cocainize is to suck up into a glass dropper 15 to 20 drops of the solution and inject it into the urethra. In the female, part of the injection goes into the bladder. In the male the solution will have to be milked down with the fingers into the prostatic urethra so that it will reach the most sensitive portion of the canal. If the bladder is very irritable a few drops of cocaine may be injected into it with the distending medium when this is introduced. The parts are dulled at the end of a few moments and when this has happened the examination may begin.

From six to twelve ounces of the distending medium, usually a two per cent. solution of boric acid, are now slowly injected into the bladder, more being injected in the female than in the male. In the former the bladder base lies on the same plane as that of the floor of the urethra and it may be difficult to find the orifices unless there is good distension.

The lamp of the cystoscope is now tested and the electricity is then turned off. Either a portable battery or the street current with rheostat may be used. The former is usually preferable because with it fewer lamps are likely to be burned out. The cystoscope is now lubricated with glycerin and is gently passed into the bladder.

To find the ureteral opening, and to introduce the catheter, the following rules may be followed.

The cystoscope being in the bladder, the beak of the instrument is drawn toward the vesical neck until it just

[1]The Electric Illumination of the Bladder and Urethra, London 1889, p. 232.

touches it; the instrument is then pushed into the cavity of the bladder two and one-half centimeters; then it is rotated on itself so that the beak describes a turn of thirty degrees from the horizontal; the lamp is then turned on. Frequently the orifice appears without further manipulation. Sometimes, however, it will be necessary to turn the beak a little to the right or left, or forward or backward, before the orifice appears. The interureteric bar is often a valuable landmark in difficult cases; the orifice is always situated at the outer extremity of this bar. Occasionally it will be necessary to inject a little more fluid into the bladder or to withdraw a little before the orifice can be found. Sometimes raising the hips of the patient a few inches facilitates the examination. Having found the opening, the cystoscope is so placed that the orifice appears to occupy a position a little below the center of the field, and a little towards the side which is to be catheterized. This is accomplished by swinging the ocular or outer end of the cystoscope, toward the opposite side of the patient. This movement brings the beak of the instrument nearer the ureteral orifice, and catheterization is thereby facilitated. The catheter is then pushed gently so that it appears well in the field. Then the deflector is slightly raised, and the catheter begins to point toward the orifice. When it appears to be in the proper direction it is pushed slowly, and as it advances it is possible to judge whether it has the proper aim. If necessary, when the tip of the catheter is near the ureteral orifice its direction may be modified by raising or lowering the deflector. When the tip is a short distance above the ureter it is usually in proper position. It is, of course, only apparently "above"—that is, "above" in the field; in reality it lies in front (nearer the neck of the bladder), and slightly to the inner side of the ureteral mouth. Slight movements of the cystoscope as a whole will aid in securing the right direction. The catheter when near the orifice may often be entered by motions of the

cystoscope alone. If the catheter bends on itself or does not easily enter, the position is changed by slightly raising or lowering the deflector. After a little practice we learn just how far to push the catheter before giving it the complete deviation. Great care must be taken not to allow the lamp to touch the bladder wall. A severe burn may follow neglect of this precaution. When the catheter has finally entered the ureter it is pushed well into the canal. If the cystoscope is a double catheterizing instrument the opposite ureter may be catheterized, if desired, by employing the same means. To withdraw the cystoscope, leaving the catheters in place, the electricity is turned off and the cystoscope is slipped off from the catheters, which are thus left in the canals. The technique varies somewhat according to the kind of instrument used.

It is not always necessary to catheterize both ureters, especially when it is a question of separating urines which are being drawn for the purpose of testing the functional capacities of the kidneys. If we can collect all the urine as it comes from one kidney by means of a large sized ureteral catheter which fits snugly into the ureter, and at the same time if we allow another catheter to lie in the bladder, the latter catheter will collect the urine as it comes from the opposite side.

The usual catheterizing cystoscopes will take only a No. 8 French catheter, which is not large enough to fit snugly into all ureteral canals; consequently urine may trickle down along the sides. In the female, we can, of course, with the Kelly tube cystoscope or with the writer's instrument, soon to be described, introduce any sized catheter. In the male this difficulty has been overcome by the ingenious expedient devised by Albarran.[1] A long whalebone bougie of small diameter with flexible gum tip is first passed into the ureter with the ordinary cystoscope. This serves as a guide upon which ureteral catheters of any desired diameter may

[1]Rev. de Gyn. et de Chir. Abd., 1897, vol. 1, p. 473.

be passed when the cystoscope has been withdrawn. The catheter used with this guide is a small tube with one or two side perforations at the renal end. By means of a cystoscope passed alongside the catheter when it is in place it can be readily seen whether or not the catheter completely fills the lumen of the ureter.

As to the kind of instrument best suited for cystoscopic examination, this will depend on the preference of the examiner. Almost any instrument is a good one in efficient

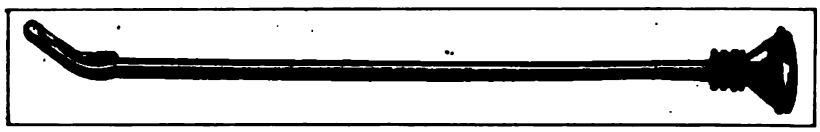


Fig. 51.—Albarran Cystoscope. Optical Portion.

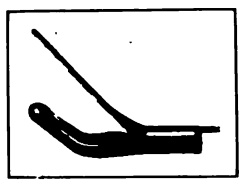


Fig. 52.—Albarran Cystoscope. Movable Cutter.

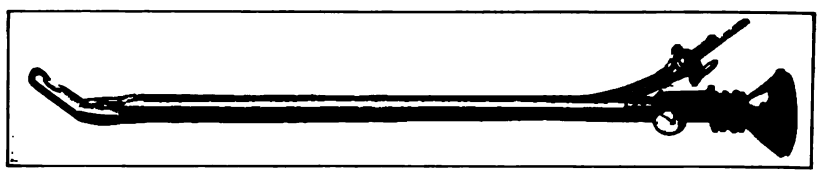


Fig. 53.—Albarran Cystoscope. Complete Instrument.

hands. In both the male and the female the water cystoscopes will be found comfortable for the patient. In the female the Kelly tube will sometimes be desirable, especially in cases in which there is hemorrhage going on. With the patient in the exaggerated dorsal or knee-chest position a ureteral hemorrhage, however abundant, will be detected with ease, whereas with a water cystoscope the great amount of blood poured out would obscure the vision so that nothing could be seen. The Albarran cystoscope

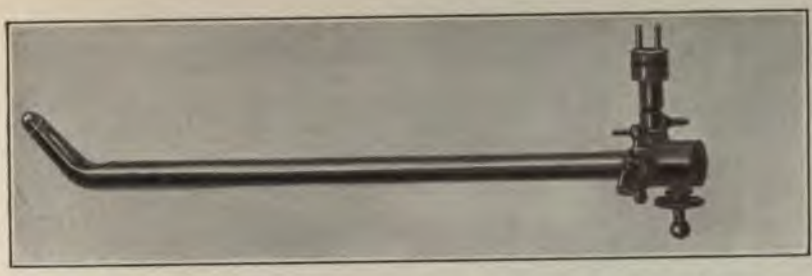


Fig. 54.—Tilden-Brown Cystoscope. Electric light and outer tube.

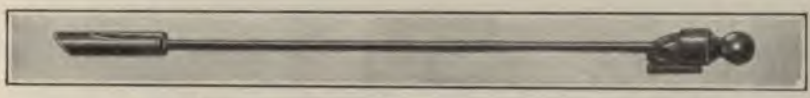


Fig. 55.—Tilden-Brown Cystoscope. Plunger, fitting into outer tube

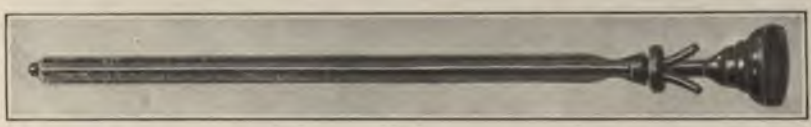


Fig. 56.—Tilden-Brown Cystoscope. Telescope and Catheterizing Apparatus.

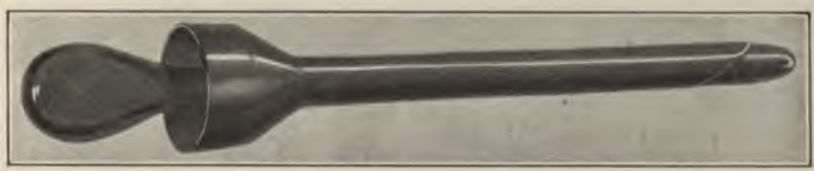


Fig. 57.—Garceau's Cystoscope, showing outer Tube with plunger, ready to be passed through the Urethra into the Bladder.

Fig. 58.—Garceau's Cystoscope, showing the Removable cap with Lens, also Electric Light Shaft and Catheter Tube. The Catheter Tubes are made of different sizes.

(Figs.51, 52, 53) is an excellent one, also the Wossildo and the Bierhoff; all of these are catheterizing instruments. In most male cases and particularly in the female, the Tilden-Brown cystoscope (Fig. 54, 55, 56) is excellent. It gives a large field, and for simplicity and ease of manipulation has much to recommend it; there is a double catheterizing apparatus.

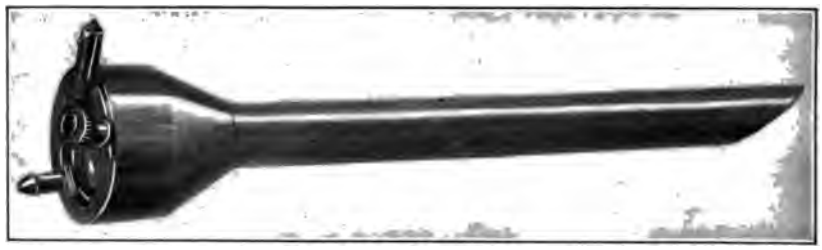


Fig. 59.—Garceau's Cystoscope, showing the Instrument as it appears in the bladder. The removable cap, to which is attached the electric light shaft and Catheter Tube, has been inserted into the Outer Tube.

The Otis cystoscope is likewise a good one for simple inspection of the bladder.

The writer has found very convenient for use in the female an instrument which he devised some years ago (Figs. 57, 58, 59, 60). It consists of a simple tube with a magnify-

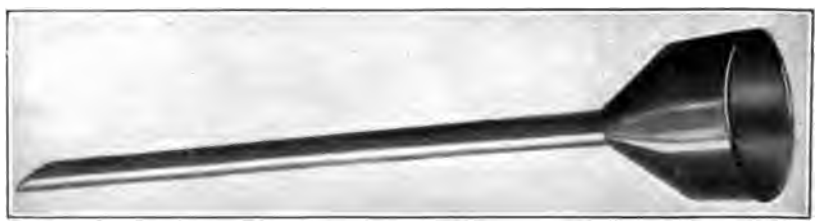


Fig. 60.—Garceau's Cystoscope, showing small sized tube.

ing glass of slight power at the outer end (Fig. 59). This glass is attached to a removable cap (Fig. 58) through which passes the electric light attachment and also the tube through which the ureteral catheter is passed. The electric light shaft and the ureteral catheter are made of flexible metal so that the cystoscope tube may be of different sizes,

and a small or a large size may be used at will. A small battery furnishes the electricity. It is either a water or an air cystoscope, and, according as the examiner wishes, either medium may be employed. The air is apt to cause some pain, but this medium may have to be used if there is a copious hemorrhage. The instrument is a short one, and the view being a direct view, there is very little trouble in finding the ureteral orifices. It is especially advantageous in difficult cases. Large catheters may be introduced with this instrument, for the bore of the catheter tube is much larger than that in any other cystoscope. This will be found advantageous when it is desired to introduce a large catheter for the purpose of collecting all the urine as it flows from the ureter; with most instruments only a small catheter can be introduced. These small instruments do not occlude the ureter completely, consequently, urine may flow down along the side of the instrument.

In the female the Kelly tube has still many adherents. It is, however, much more disagreeable to the patient if a knee-chest position is used and its introduction is also more painful. The technique is simple. The patient kneels down on the table in such a way that the chest hugs the level of the table. This elevates the hips, and when the speculum is introduced into the bladder air rushes in and distends it. Light is now reflected into the tube by means of a head mirror and usually the orifices will be easily found.

In thin patients the elevated dorsal position is sometimes serviceable and it is far less disagreeable than the knee-chest position. The hips are raised eighteen or twenty inches or more with pillows and distension is secured in this way. The constant accumulation of urine in the bladder as it flows from the kidneys sometimes obscures the view with the elevated dorsal position, and to overcome this difficulty the writer some years ago added to the Kelly cystoscope a small tube, which is soldered along the floor of the instrument. A suction apparatus, worked by an assistant,

keeps the bladder dry and greatly facilitates the examination (Fig. 61).

As to the choice of methods of separating urines, a good deal depends upon the preference of the examiner. In the female, and in many males, the Luys instrument is excellent. There is no danger of infecting healthy kidneys; it is easy of introduction; and the results are good in the majority of cases. On the other hand, it cannot remain long in position,

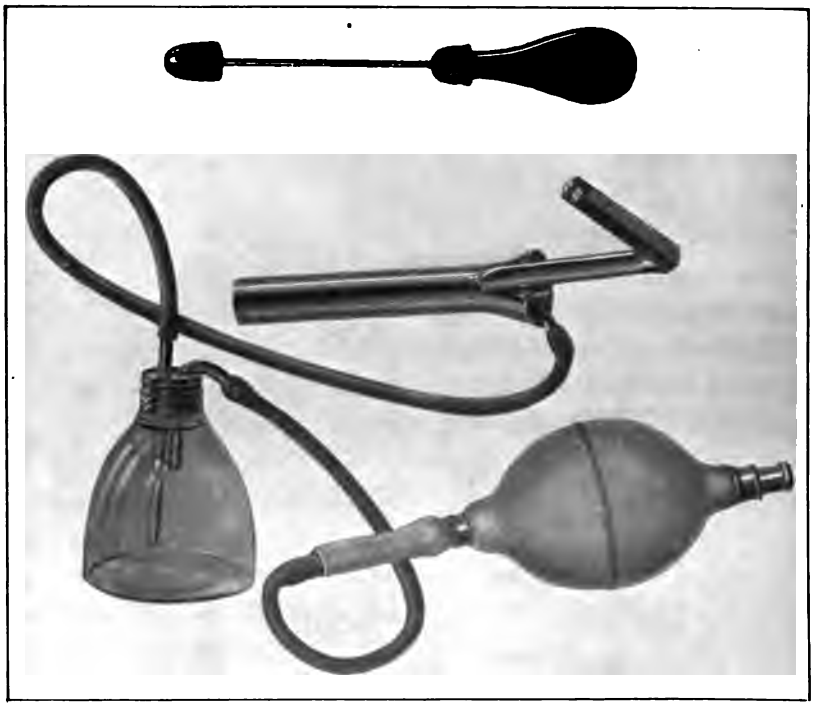


Fig. 61.—Garceau's modification of the Kelly cystoscope.

and its use requires the constant attendance of the examiner.

Ureteral catheters may be left *in situ* for several hours and must be used when performing the long tests for ascertaining the renal function. They must always be used in males at the age when prostatic troubles are apt to occur, and also in males with old inflammatory affections of the urethra, particularly of the posterior urethra. In urethral

narrowing due to inflammation the Luys instrument is difficult of introduction and may cause hemorrhage; in prostatic cases the curve of the instrument is not adapted for the base of the bladder. In young males the Luys instrument works perfectly well.

Much has been written about the supposed dangers of infecting healthy kidneys by passing the catheters through a diseased bladder. The writer is in accord with many observers who have not found this danger a real one, and he has many times performed this slight operation through infected bladders without noting any serious results. At the same time, catheterization of ureters under these circumstances must be avoided if possible.

If it is desired to draw all the urine from one kidney by ureteral catheterization, a large catheter must be used. The writer's instrument, shown on pages 376 and 377 will, in the female, be found advantageous. There is a very large sized catheter tube in this instrument and this tube will take a larger bore catheter (No. 11 French) than any other cystoscope with which the writer is familiar.

In small children ureteral catheterization is not possible, and the only way to separate the urines in these cases is by means of a small sized Luys instrument.

EXAMINATION OF THE URINES OF THE TWO KIDNEYS

The examination of the separated urines will give information of value. It will in the first place, show if pyuria is present. Even a slight amount of pus may be symptomatic of serious renal disease. The same is true of microscopic amounts of blood. Casts, various kinds of epithelium, and crystals should all be looked for.

The specific gravity will vary according to the concentration of the urine. In general terms, a high specific gravity with a good amount of urine flowing in a given time is

indicative of a healthy kidney. The opposite condition, low specific gravity with a small amount of urine, is an unfavorable sign.

The secretion of urine of two healthy kidneys varies widely under diverse circumstances. Not only this, but two healthy kidneys will not, in a given time, secrete the same amount of urine containing the same amount of solids. The 24-hour output, however, by each kidney in a condition of health, is practically the same. A normal kidney will secrete about 600 or 700 ccm. in 24 hours, containing from 12 to 15 grams of urea and 5 to 6 grams of chlorides.

It has furthermore been ascertained that instrumentation may seriously interfere with the secretion of urine. The writer has seen a case in which double anuria lasting three days followed simple catheterization of the ureters. Temporary oliguria and also polyuria are very common. These changes in the secretion of urine may follow both catheterization of the ureters and intravesical separation. Polyuria is very apt to occur in nervous hysteric females, although it may also be seen in healthy individuals. It is more common that differences in the amount of urine should occur than that there should be any change in the amount of solids excreted and it has furthermore been observed that modifications of any kind are apt to be transitory. For this reason, many prefer, when it is desired to get urine for the purpose of chemical examination, to use the ureteral catheters which may remain *in situ* for a considerable length of time.

The secretion of a diseased kidney is usually less than a normal one; when both kidneys are diseased in the same individual the one more seriously affected usually secretes less than its fellow. Other things being equal, a healthy kidney shows an increased secretion of urine. Again, the healthy kidney may not secrete more urine than the other, but it may be richer in solid constituents and in these cases the specific gravity is higher.

The estimation of the urea amount was at one time thought to be a very valuable test for determining the functional capacity of the kidney. The watery constituents of the urine, however, differ so much in amount under varying conditions as to make the test *per se* of very little value. Polyuria may depend on nervous influences and on the ingestion of large amounts of water; while the opposite condition, oliguria, is dependent likewise on nervous influences, and diminished ingestion of fluids. The secretion is likewise lessened by sweating or by diarrhea, etc.

The total amount of urea is likewise dependent largely on the quantity of proteid matter taken with the diet. Large amounts of meat increase the urea amount and a vegetable diet has the opposite effect.

The fluctuation of chlorides in the urine follows similar laws. It has been noted, however, that sodium chloride is more easily eliminated by a diseased kidney than is urea.

The urea percentage test has, however, a certain value in estimating the functional capacity of a kidney. A high urea percentage, combined with a normal or an increased amount of urine of high specific gravity, is suggestive of a healthy kidney, especially if opposite conditions hold on the diseased side.

A large amount of urine of low specific gravity, with a low percentage of urea, should be especially under suspicion, particularly in an elderly person. Senile changes in the nature of interstitial nephritis form the most serious menace in a contemplated nephrectomy, and these changes are very frequently found. The writer believes that nephrectomy should not be performed with a persistent low urea percentage and a low specific gravity. The absence of casts is not an argument in favor of operation, for casts are apt to be scarce in such a urine and they may not be observed by even a very competent examiner. It is better in the presence of such a urine to delay the operation until a chronic interstitial nephritis can be absolutely ruled out.

Meanwhile other examinations may be made. Other symptoms of nephritis should not escape observation, for instance, hypertrophy of the heart, calcareous arteries, slight edema, etc. Unrecognized chronic interstitial nephritis affecting the opposite kidney is responsible for many postoperative deaths.

TESTS FOR DETERMINING THE FUNCTIONAL ACTIVITY OF THE TWO KIDNEYS[1]

The Phloridzin Test

The phloridzin test for estimating the functional activity of the kidneys has been in vogue for some years and, if too much is not expected of it, serves its purpose pretty well.

Phloridzin is a glucoside obtained from certain barks. When it is injected into the body by subcutaneous injection it causes a temporary glycosuria.

The method of performing the test is as follows: In the first place, a reliable preparation of the drug must be obtained, otherwise the test will not give good results. The solution likewise must be freshly prepared as it precipitates and forms crystals which are deposited at the bottom of the bottle. Its composition is also likely to become changed on standing.

A subcutaneous injection of 30 minims of a 1:400 solution of phloridzin is made in the deep tissues. This amount corresponds to five milligrams of phloridzin.

The test to be of any value in estimating the functional activity of the two kidneys must be preceded by the introduction of the ureteral catheters. The urine is collected by this means and each specimen is examined separately for sugar. The examination is made by ordinary quantitative methods of estimating sugar. In order to get enough urine

[1]The writer is greatly indebted to Walker's excellent work, The Renal Function in Urinary Surgery, London, 1908.

for the test it is well to give a diuretic three-quarters of an hour before the test begins; a good drug for this purpose is dimethylxanthine (theocin) in the dose of six grains, in capsule form. The total amount of sugar excreted by the kidneys with the phloridzin amounts ordinarily to from one to two grams.

The test is a rapid one and its performance occupies

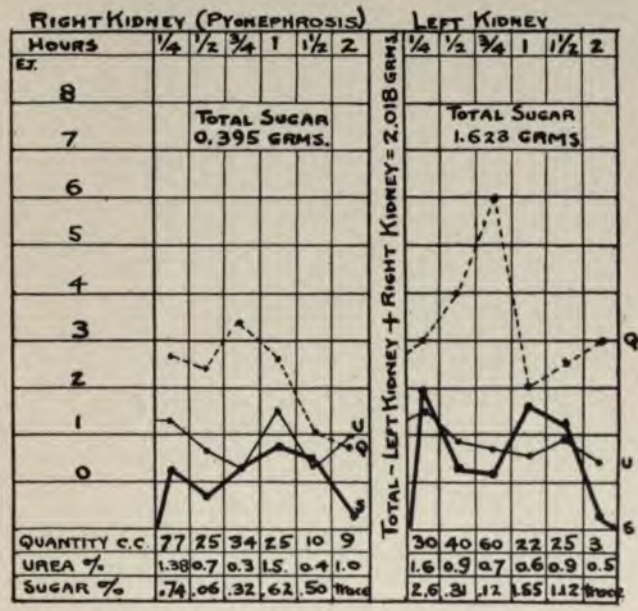


Fig. 62.—Phloridzin Test. Calculous pyonephrosis; diminished elimination of sugar on diseased side. Observations made every quarter of an hour for one hour, then every half hour. S indicates the course of glycosuria, U the course of urea excretion, and Q the quantity of urine. From Thomson Walker: The Renal Function in Urinary Surgery. London, 1908, p. 245.

about two hours, a time compatible with stationary catheters in the ureters.

In diseased conditions of the kidneys the sugar excretion may be slight in amount, delayed in appearance, or it may be absent altogether (Figs. 62, 63, 64). In most cases in which a kidney is not badly diseased the elimination begins at the same time as that in the healthy kidney, but it is

diminished in amount on the diseased side (Fig. 62). Complete absence of sugar usually denotes advanced renal disease. The urine should be collected from each kidney at the end of every quarter hour during the first hour, and at half hour intervals during the second hour, and it should be examined for sugar percentage.

The sugar will appear in the urine from the healthy side at the end of fifteen or twenty minutes; it will be highest in

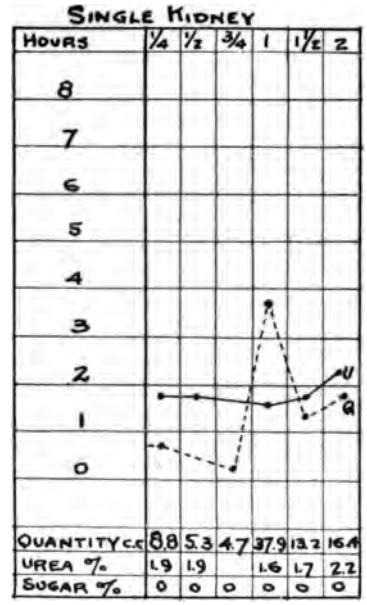


Fig. 63.—Phloridzin Test. Absence of phloridzin glycosuria in solitary diseased kidney after nephrectomy for phonephrosis. From Thomson Walker: The Renal Function in Urinary Surgery, London, 1908, p. 142.

amount at the end of three-quarters of an hour; and it will cease to be eliminated at the end of from two to two and one-half hours (Figs. 65, 66).

It is best, at the same time that the sugar is estimated, to test for urea, chlorides, and phosphates, and to note the amounts of urine passed by each kidney. It is also well to estimate the total amount of sugar passed.

FALLACIES.—The elimination of sugar by a healthy kid-

ney is not always the same, and it has been found that even two healthy kidneys in the same individual will eliminate sugar in unequal amounts. A variation of from 10% to 20% has been found by Walker.[1] Sometimes, though rarely, a normal amount of sugar has been excreted by a kidney badly diseased, but this has happened very infrequently.

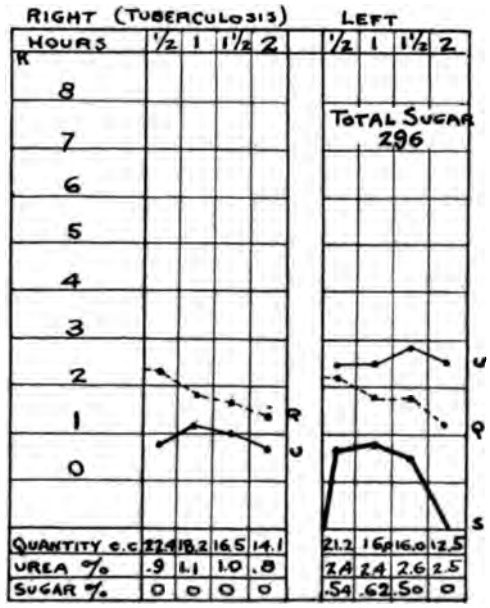


Fig. 64.—Phloridzin Test. Tuberculosis right kidney; absence of phloridzin glycosuria on diseased side. From Thomson Walker: The Renal Function in Urinary Surgery, London, 1908, p. 249.

Walker[2] mentions the case of a man of nervous temperament, who suffered from attacks of left renal colic; the painful kidney eliminated .46 gram of sugar and the supposedly healthy kidney none at all. It is possible that the catheter in the ureter may inhibit the secretion of sugar, but about this nothing is known. The absence of sugar has been noticed in catarrhal jaundice, alcoholism, arteriosclerosis and epilepsy.

[1]The Renal Function in Urinary Surgery, London, 1908, p. 243.
[2]The Renal Function in Urinary Surgery, London, 1908, p. 250.

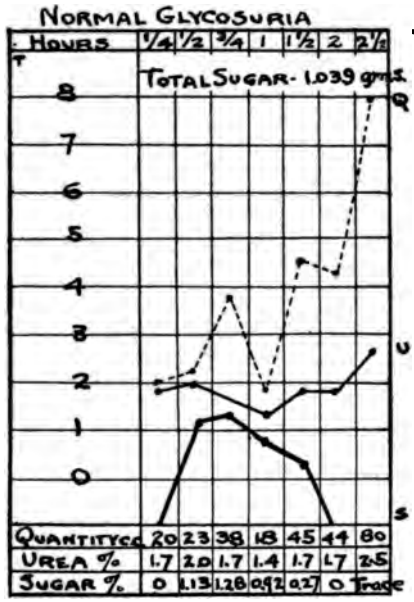


Fig. 65.—Phloridzin Test. Normal glycosuria after injection of 5 mgr. of phloridzin. From Thomson Walker: The Renal Function in Urinary Surgery, 1908, p. 133.

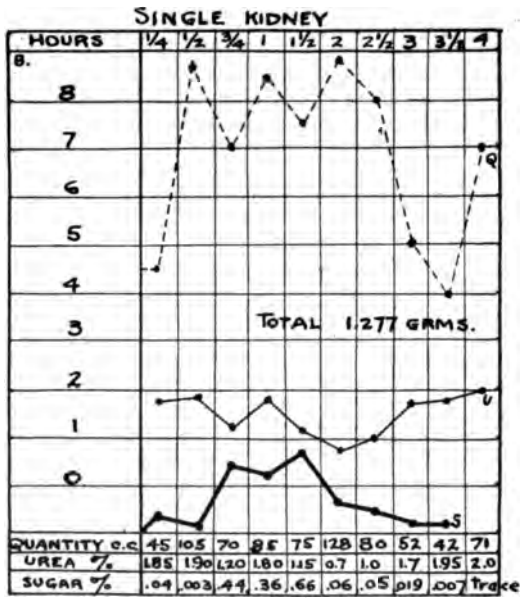


Fig. 66.—Phloridzin Test. Normal phloridzin glycosuria after nephrectomy. From Thomson Walker: The Renal Function in Urinary Surgery, London, 1908, p. 141.

The test, however, is a delicate one, rather too delicate in fact, and it has been found that slight grades of kidney disturbance may cause considerable fluctuation in the phloridzin curve. Nevertheless, the test is a good one and, if taken with other signs and symptoms, may be relied upon with some assurance. It has the advantage over all other tests in its simplicity and in the short time required for its performance.

Other tests for determining the functional capacities of the kidney are: (1) the cryoscopic test of the urine and the blood, (2) the methylene blue test, and (3) the Albarran polyuria test.

The three tests are corroborative of the phloridzin test and may be used as such if so desired.

THE CRYOSCOPIC TEST OF THE URINE AND THE BLOOD

The function of the kidneys is to separate from the blood a fluid which contains excrementitious substances noxious to the body. This fluid, the urine, has a definite molecular composition. By freezing the urine and noting the freezing point the molecular content of the fluid may be ascertained and the point is also an index of the osmotic pressure of the urine. The kidneys have the function of extracting from the blood a fluid of greater osmotic pressure than that of the blood itself, but if the kidneys are diseased this power is considerably reduced, so that the osmotic pressure falls; under these circumstances the freezing point of the urine is raised. The work performed by the kidneys, therefore, may be measured by estimating the osmotic pressure of the urine, and a still better estimate can be made by also estimating at the same time the osmotic pressure of the blood.

The freezing apparatus usually employed is that devised by Beekmann (Fig. 67). The apparatus is figured on page 388.

The method of using is as follows: In the first place,

the thermometer should be adjusted. The mercury should stand within two or three degrees of the top of the scale when the thermometer is cooled to the freezing point of distilled water, which must be used for the purpose of comparison. The bulb of the thermometer is warmed gently with the hand until the mercury commences to run out of the capillary tube into the chamber at the upper end of the

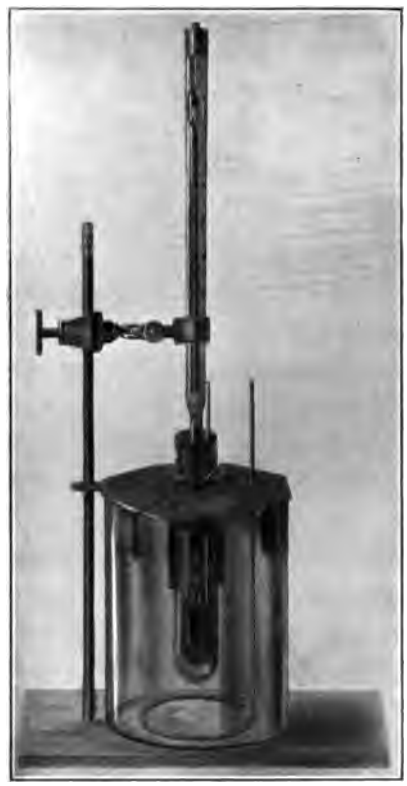


Fig. 67.—Beekman apparatus for determining the freezing point of fluids.

instrument. The thermometer is then inverted and jarred to cause union of any mercury in the chamber with that in the capillary. The bulb is then placed in a bath whose temperature is about four degrees higher than the freezing point of distilled water (4° C.), this point having been ascertained by means of an ordinary thermometer. After

waiting for the mercury to reach the temperature of the bath the Beekmann thermometer is removed and quickly given a downward jerk in order to separate the mercury remaining at the top of the chamber from that in the capillary. If, on being placed in the freezing distilled water, the mercury proves not to have been properly located the process should be repeated, after modifying the temperature of the bath.

A mixture of finely crushed ice and salt is now placed in the glass jar of the apparatus and the two tubes, one within the other, are placed in the mixture. Into the inner tube are now poured from 10 to 18 cc. of distilled water. The Beekmann thermometer is now placed in the inner tube so that the mercury bulb is exactly in the centre of the distilled water. The stirrers are used both for the ice and salt mixture and for the water in the inner tube. The mercury will slowly fall to a point below the real freezing point of the distilled water, and then, as crystallization begins, will rise again. When this rise commences, the rate of stirring should be greatly increased, and several readings made of the highest temperature reached by the thermometer, tapping the thermometer gently on its top to overcome the "lag" of the mercury. The highest point reached by the mercury is to be taken as the freezing point of the water. This process should be repeated until concordant results are obtained. The second time it is done the freezing point will be found slightly higher; this is accounted for by the presence of certain impurities in distilled water, such as carbonic acid; these impurities are gotten rid of by the freezing.

Urine or blood may be frozen in the same manner; the difference between the freezing point of the distilled water and the fluid examined represents the lowering of the freezing point.

In handling the thermometer care should be taken that it is not subjected to sudden changes of temperature; and it should be remembered that jarring may cause a re-union

of the two separated portions of mercury, thus necessitating a readjustment.

Each degree Centigrade on the Beekmann thermometer is divided into one hundred parts on the scale.

Cryoscopy of the Urine

In order to simplify the reading of the formulae used to express results obtained by this test, certain signs are made use of. The sign $\triangle U$ is used to express the point at which the urine freezes.

In conditions of health the freezing point of the urine varies considerably according to the state of dilution. In ordinary conditions $\triangle U$ may vary between—1.30° C. and —2.20° C. It is also influenced by the physical condition of the patient. For instance, Albarran[1] found it—.46° C. in a neurotic individual.

It is at once evident that comparative cryoscopy of the separated urines will give information of very little definite value. The changes in the urine due to the ingestion of different kinds of food and of varying amounts of water, sweating, nervous influences, etc., will alter the point $\triangle U$ in much the same way that they do urea percentages. It would be necessary, in order that the test should have any positive value, to collect the separated urines for 24 consecutive hours, and that the examinations should be repeated on successive days, conditions manifestly impractical.

Some information, however, may be given by comparative cryoscopy, especially if the test is used in conjunction with other tests. In general terms the following is true:

(1) A diseased kidney will secrete a urine of lower specific gravity and less concentration than one which is healthy. This will raise the point $\triangle U$.

(2) Polyuria on the diseased side will still further raise the point $\triangle U$.

[1]Exploration des Fonctions Renales, Paris, 1905.

(3) A considerable amount of urine and a low point △U is indicative of a functionally active kidney.

(4) It has been shown that the slighter grades of renal disease do not seriously affect △U values.

Cryoscopy of the Blood

The freezing point of the blood (designated △B) and of the serum is the same. It is quite constant at —.56° C. in the normal individual. This forms the basis of the test.

The specimen of blood may easily be obtained either by cupping or by incising the median cephalic vein of the forearm. About 15 ccm. will suffice.

If the opposite kidney is doing a sufficient amount of work for the needs of the body the freezing point of the blood will not, as a rule, be appreciably altered.

In double renal disease, however, there is increased concentration of the blood and the point △B is frequently lowered. Point △B of —.60° C. is to be regarded as a sign of importance and anything lower than that is, of course, a very grave sign.

If a lowered freezing point of the blood resulted from diseased kidneys and nothing else, the value of the test would be greatly enhanced. This is not the case. Beer[1] has pointed out, in summing up the inaccuracies of the test, that disturbances in proteid metabolism, anemias, acetonuria, as well as the nature of the patient's diet, affect the concentration of the blood. The following diseases are known to be occasionally associated with a low △B point: cirrhosis of the liver, large abdominal tumors, especially those of the ovary, the prodromal stage of malaria, the terminal stage of malignant disease, diabetes, uncompensated heart disease, eclampsia, and also during epileptic attacks. A low △B point has also been due to renal colic, even when the corresponding kidney has been functionally well. Finally, it has been shown by Israel[2] that the point △B may be even

[1] Amer. Jour. Med. Sci., 1906, n. s., vol. 131, p. 205.
[2] Berl. klin. Woch., 1902, vol. 39, p. 134.

higher than that of normal blood and still there may be grave double renal disease.

It is evident, therefore, that the test *per se* has no positive value and it is to be regarded as merely corroborative of other tests.

The test has been modified by Léon Bernard,[1] who compares the molecular content of the blood and the urine. Bernard's test is not applicable to the separated urines, but the whole amount must be considered. It is, therefore, of value only when both kidneys are diseased and it is desired to see what they are both doing together. Bernard's formula is

$$\frac{\triangle U}{\triangle B} = R.$$

Here $\triangle U$ represents the freezing point of the urine and $\triangle B$ that of the blood; R is the quotient, which in health varies between 2.30 and 3.90.

The value R shows renal permeability, expressed in figures, in variations of molecular concentration of the urine. But it is necessary to multiply this value R by the volume (V) of the urine passed in 24 hours. The working formula is

$$\frac{\triangle U}{\triangle B} \times V = R.$$

Normal values of this formula range, in a state of health, from 3,000 to 5,000.

The difficulty with this method is that while $\triangle B$ varies but little, $\triangle U$ may vary considerably, and in cases in which there is marked oliguria the test is of very little assistance. Bernard himself calls attention to this and he states[2] that the method should always be used in conjunction with examination of the separated urines.

[1] Les Méthodes d'Exploration de la Perméabilité Rénale, Paris, 1903, p. 97.

[2] Les Méthodes d'Exploration de la Perméabilité Rénale, Paris, 1903, p. 187.

METHYLENE BLUE TEST

The Methylene Blue Test, as will be shortly shown, finds its field of usefulness in cases in which both kidneys are diseased. When one kidney alone is affected, the test is not very satisfactory.

The method was first discovered by Achard and Castaigne,[1] who reported numerous observations which went to show that renal lesions were associated with retarded appearance and diminished elimination of methylene blue as compared with sound kidneys.

It is necessary that a pure preparation of methylene blue be used.

The drug is not absorbed from the site of injection as methylene blue, but it undergoes some change, the nature of which is not known, and it enters the lymphatics as a substance called chromogen, which is colorless. Having entered the system, part of the chromogen is again changed in the liver into methylene blue and appears in the intestines with the bile. The chromogen which enters the kidney is excreted by these organs, partly as chromogen and partly as methylene blue. The methylene blue excreted by the kidneys, of course, gives a blue tint to the urine. The chromogen, being colorless, is not apparent, but it becomes so if a few drops of acetic acid are added to the urine and it is boiled; it is then transformed into the blue and gives a blue tint to the urine.

About 50 per cent. (or 25 miligrams) of methylene blue absorbed reappears in the urine during the first twenty-four hours in a healthy individual. The method of performing the test is as follows:

The bladder is first emptied of its contents. Then 15 minims of five per cent. aqueous solution of the methylene blue are slowly injected into the the buttock. This corresponds to 50 miligrams of the drug. The urine is then collected in separate receptacles, at the following intervals:

[1] Soc. Méd. des Hôp., Paris, 1897, vol. 14, 3d series, pp. 637, 831.

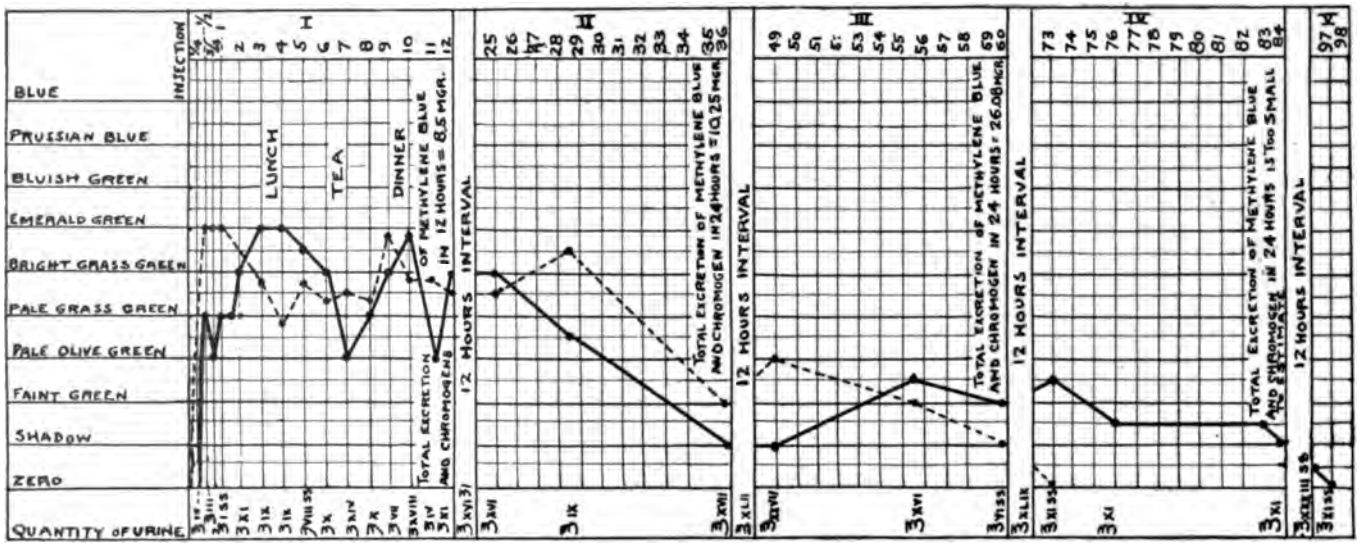

BLUE
PRUSSIAN BLUE
BLUISH GREEN
EMERALD GREEN
BRIGHT GRASS GREEN
PALE GRASS GREEN
PALE OLIVE GREEN
FAINT GREEN
SHADOW
ZERO
QUANTITY OF URINE
INJECTION
LUNCH
TEA
DINNER
TOTAL EXCRETION OF METHYLENE BLUE IN 12 HOURS = 8.5 MGR.
AND CHROMOGEN
12 HOURS INTERVAL
TOTAL EXCRETION OF METHYLENE BLUE AND CHROMOGEN IN 24 HOURS = 10.25 MGR.
TOTAL EXCRETION OF METHYLENE BLUE AND CHROMOGEN IN 24 HOURS = 26.08 MGR.
TOTAL EXCRETION OF METHYLENE BLUE AND CHROMOGEN IN 24 HOURS IS TOO SMALL FOR ESTIMATE

Fig. 68.—Methylene Blue Test. Elimination of methylene blue (continuous line) and chromogen (dotted line) in a healthy individual. The total quantity of methylene blue and chromogen passed in each 24 hours is given in milligrams and the quantity in ounces. From Thomson Walker: The Renal Function in Urinary Surgery, London, 1908, p. 104.

fifteen minutes, thirty minutes, one hour, and then every hour until the color is well marked. Then the whole twenty-four hour amount is set aside, and each twenty-four hour amount subsequently is set aside, until there is no longer any trace of color in the urine.

In healthy subjects the urine appears changed at the end of thirty minutes. At first a faint color is seen. This

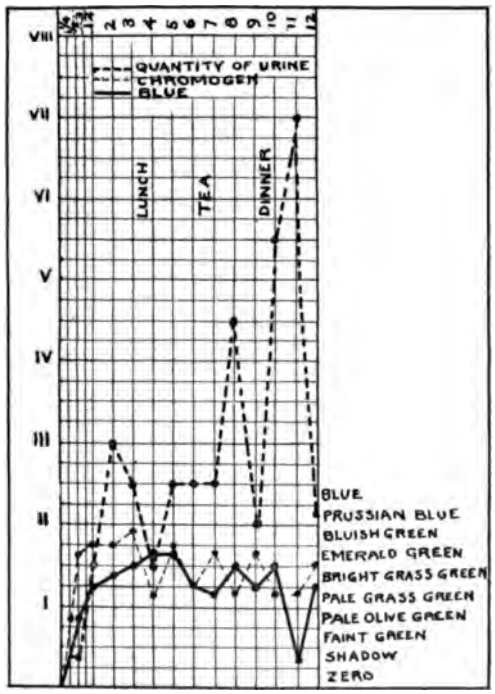


Fig. 69.—Methylene Blue Test. Normal elimination of methylene blue (continuous line) and chromogen (fine dotted line) compared with quantity of urine (heavy dotted line) during first 12 hours after injection. From Thomson Walker: The Renal Function in Urinary Surgery, London, 1908, p. 96.

gives way to a rapidly deepening color, until, at the end of from one to four hours, the color is an emerald green or a Prussian blue; in many cases the color remains an emerald green (Figs. 68, 69). Occasionally the deepest coloration is not reached, however, until some hours later than that indicated. The highest degree of elimination usually occurs

at the end of three hours and it maintains this rate for about four or five hours; it then begins to fade.

Usually the chromogen begins to be eliminated by the kidneys before the methylene blue, and it may be detected at the end of fifteen minutes or so. Five minutes' boiling with a few drops of acetic acid brings out the color.

It is necessary, if there is already a tint of methylene blue in the urine, to extract it by shaking the urine in a test tube into which has been poured a little chloroform; this extracts the coloring matter and the supernatant liquid may then be decanted and tested in the way described. It may be necessary to shake several times with chloroform before all the blue is extracted. It is evident that methylene blue must be extracted in this way before testing for chromogen during the whole performance of the test, for, the elimination of each being separate and distinct, it is necessary to determine the amount of each one.

Chromogen is in excess of methylene blue for the first four or five hours; then the methylene blue is excreted in greater amounts and this holds until all the coloring matter has been passed. Usually, all the chromogen has been eliminated before all the methylene blue has been passed.

In all, elimination of methylene blue in a healthy person lasts from 40 to 60 hours, although it has been detected several days after the injection has been given.

Sometimes there are certain peculiarities manifested in the elimination of the methylene blue.

The careful observations of Walker[1] have proven this. Walker mentions "nervous excitement and hypertrophic changes in a kidney" as factors conducive to intermittent elimination.

Furthermore, the coloration may vary. The depth of color in some cases does not exceed grass green, even with kidneys perfectly healthy.

It is desirable to ascertain just how much blue is elim-

[1]The Renal Function in Urinary Surgery, London, p. 106.

inated during the first 24 hours of the test, for this helps us to determine the capacity of the kidneys. It will be necessary to transform the chromogen into blue before performing the test, for the basis of its performance is the coloration of the urine. The method of Archard and Clerc[1] is the best one.

Twenty-five ccm. of the blue urine, which has previously been boiled with acetic acid to reduce the chromogen, are poured into a beaker. Into another beaker are poured twenty-five ccm. of the mixed twenty-four hour urine, previously passed by the patient.

Then an equal amount of water is added to each beaker, until the fluid in the blue glass has been reduced to a pale tint. This will take two or three quarts of water.

Then a 1:10,000 solution of methylene blue is added, drop by drop, from a burette, into the beaker containing the pure urine and water, until the tint of the two beakers is similar. This is best ascertained by placing a sheet of white paper behind the beakers.

The amount of blue in the burette which was used to color the urine and water, allows us to compute the amount of methylene blue in the stained urine. Thus, if 3.1 ccm. of the burette solution were used, this would represent .31 miligram of the blue, and this is the amount of blue contained in twenty-five ccm. of stained urine. Supposing the twenty-four hour amount to have been 2000 ccm., the total amount of the blue will be,

$$\frac{31 \text{ mgr.} \times 2000}{25} = 24.8 \text{ mgr.}$$

This is about half of what is injected and represents the usual amount eliminated by a healthy person.

The test, as applied to an individual who has serious disease of both kidneys, gives information of value.

Usually in serious double renal disease, there is a delay

[1]Bull. et Mém. de la Soc. Méd. des Hôp., 1900, p. 106.

in the beginning of the elimination of one, two, three hours, or even more.

In inflammatory diseases of the bladder, there is likely to be a delay in many cases. So also in conditions associated with obstruction of the urine in the lower urinary passages, is this same delay noted. An enlarged prostrate, with obstruction, is particularly likely to cause delayed elimination of the blue. In such cases there may be no change in the urea amount, yet the blue does not appear as it does in a normal individual. The test is, therefore, of more significance than the urea test.

When no blue at all is excreted, this constitutes a sign of grave importance, and under the circumstances nephrectomy should not be performed. On the other hand, as Walker [1] pointed out, it occasionally happens that no blue is excreted although the kidneys may be perfectly healthy; and Walker cites a case of a young man who took methylene blue for therapeutic purposes for a period of three months, and during that time no blue ever appeared in the urine. There was no evidence of renal disease.

Again Albarran and Bernard[2] have shown that there may be considerable delay in the appearance of the blue, even though the lesions of the kidneys may be insignificant. They cite two cases of movable kidney in which the blue appeared two and one-half and three and one-half hours respectively, after injection.

On the whole, however, a delay in the appearance of the blue may be considered evidence of renal impairment.

In most cases, the chromogen begins to pass through the diseased kidneys before the blue. As a rule, the chromogen is eliminated more easily by the diseased kidneys than is the blue.

It has occasionally been observed that chromogen alone has appeared, and that there was no elimination of the

[1] The Renal Function in Urinary Surgery, London, 1908, p. 97.
[2] Explorations des Fonctions Rénales, 1905.

methylene blue; this is rare, however, and, as a rule, both are eliminated. Finally, chromogen and methylene blue may alternate.

The duration of the elimination varies with the gravity of the disease. The chief elimination occurs, when once begun, within a few hours, but it may persist for several days in some cases. For instance, in chronic interstitial nephritis the elimination has gone on in traces for several

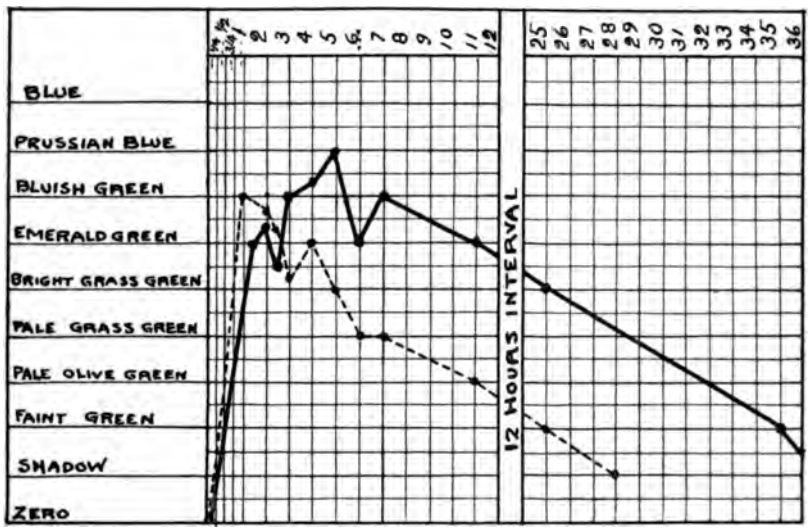


Fig. 70.—Methylene Blue Test. Elimination of methylene blue in tuberculous kidney. Delayed commencement and rapid, short elimination. From Thomson Walker: The Renal Function in Urinary Surgery, London, 1908, p. 113.)

days. An enlarged prostate is particularly apt to cause prolonged elimination of the blue. Sometimes there is delayed beginning and rapid termination (Fig. 70).

The amount of blue excreted also varies from that in health. Walker[1] cites a case of double calculous disease in which the time and duration of elimination were normal, but the quantity of blue excreted was greatly reduced.

[1]The Renal Function in Urinary Surgery, London, 1908, p. 112.

Finally, it has been noted that there may be intermissions in elimination.

As to the value of the test, it may be said that alone it is of no positive help; but taken in conjunction with symptoms, and especially in conjunction with examination of the urine and other tests, it is of positive value.

The test has a place in estimating the work of the two kidneys together, but when we come to apply it to the estimation of the work of the two kidneys separately, we are embarrassed by the necessity of collecting the two urines for a considerable length of time. At the most, catheterization of two or three hours is all that can be reasonably advised. The information that can be obtained during this short time is not sufficient, and, therefore, the test as applied to the separate kidneys can have only a corroborative value when compared with other tests. As a rule, the elimination of the blue in the healthy kidney begins within half an hour and the coloration is pronounced; while on the diseased side the blue is slow in appearing and of feeble color, and it may not appear at all; the duration of elimination on the diseased side is much shortened. Albarran and Bernard [1] were the first to show that the more the kidney is destroyed the less the amount of blue passes through. The same authors believe that intensity of elimination is a surer sign than retardation.

There is sometimes a depressant effect on the healthy side, the nature of which is not understood.

If it has been found by other methods that the two kidneys, both diseased, are doing a nearly equal amount of work, and that the excretion of the blue is diminished, and equally diminished, on each side, one would hesitate to advise nephrectomy in such a case.

If it is desired to estimate the amount of blue passed by each kidney, this may readily be done by means of a

[1] Ann. des Mal, des Org. Gén. Urin., 1899, vol. 17, p. 481.

simple apparatus (Fig. 71), devised by Walker[1]. The usual method of estimation is used as described on page 393. But instead of beakers, test tubes are used, and instead of a 1:10000 standard solution of methylene blue, a solution of a 1:5000 is used, as the 1:10000 gives a very pale blue tint and it will be found more convenient to work

Fig. 71.—Walker's apparatus for determining the amount of methylene blue passed by each kidney in a given time. From Thomson Walker: The Renal Function in Urinary Surgery, London, 1908, p. 95.

with a more concentrated solution. Small quantities of blue urine must be used.

At most, the methylene test, as applied to the two kidneys separately is merely a ready test in cases in which there is serious disease on one side and a presumably

[1]The Renal Function in Renal Surgery, London, 1908, p. 98.

healthy kidney on the other. In the lighter forms of kidney disease it gives little or no information.

ALBARRAN'S POLYURIA TEST

This test depends upon the fact that a diseased kidney has a more uniform function than one which is not diseased. Furthermore, if both kidneys are diseased, the one which is the more diseased of the two modifies its function the less. Such a diseased kidney gives a urine which does not vary very much in amount and which has a constant low output of solids.

The test is a very simple one and is carried out in the following manner:

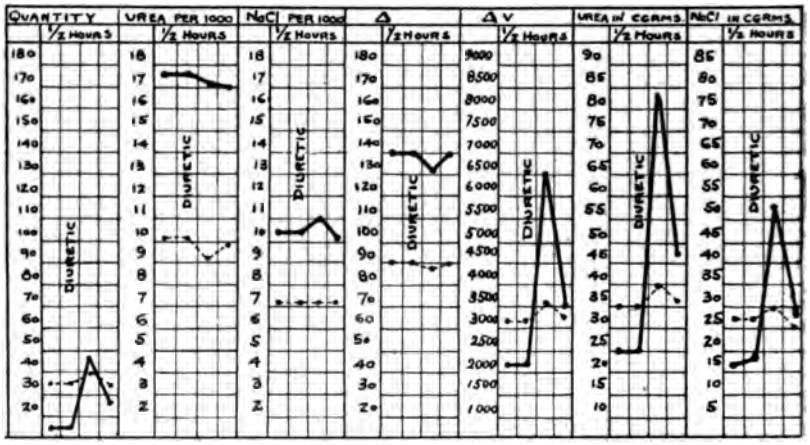


Fig. 72.—Albarran's Polyuria Test. Dotted line shows work of diseased kidney; continuous line that of healthy kidney. From Thomson Walker: The Renal Function in Urinary Surgery, London, 1908, p. 253.

The patient drinks from 400 to 600 ccm. of a diuretic water. Albarran uses Evian water. Then both ureters are immediately catheterized and the urine is collected every half hour for three hours. A chart (Fig. 72) is constructed and the following points are noted: amounts of urine; freezing points of the urines; freezing points of the urines corrected for volume (ΔV); amounts of urea and chloride

of sodium per liter and in centigrams; and the phloridzin glycosuria per liter and in centigrams.

In conditions of health, the amount of urine rises immediately and reaches the highest point at the end of the third half hour. The solids in the urine show diminished concentration.

A kidney may be considered healthy which has from 1.20 grams to 1.80 grams of urea during the two hours of the test. A moderate amount is 75 centigrams to 1 gram. Anything below this may be considered as indicative of feebly acting kidneys.

The freezing point corrected for volume shows great variations. From 12,000 to 17,000 is considered good; 8,000 to 10,000 as moderate; 6,000 or below as bad.

In diseased conditions the amount of urine is but little changed from the usual amount in disease, and the more destruction of tissue the less the change. The urea and solids may be much diminished and the freezing point is correspondingly high.

EXPLORATORY INCISION

Edebohls was the chief exponent of this method of ascertaining the condition of the kidneys previous to contemplated nephrectomy. The mortality attending this procedure is slight; nevertheless, most unfortunate accidents have happened and it cannot be considered that the exploration is quite devoid of danger.

Even when the kidney has been exposed, it is by no means easy to say that it is capable of performing good work. In a young subject, however, in whom no evidence of latent nephritis has been found, a kidney of normal size, of normal color, and of normal consistency is fairly presumptive evidence of efficiency.

The exploration will find a place in cases in which the kidney is either absent or atrophied, and no urine can be

obtained from the side in question. Also in cases in which the bladder is distorted from disease and the ureters cannot be found will this method of exploration have a field. Morris[1] found in the post-mortem records of several hospitals, six cases of absent or extremely atrophied kidneys in 15,904 examinations; and 59 less atrophied kidneys were found in 8,178 examinations.

Congenital absence of the kidney is often accompanied by some malformation in the genitals and this serves as a clue. This malformation is practically always on the same side as the renal defect. When the kidney is absent the ureter and ureteric orifice are almost invariably absent. Ballowitz[2] in 213 cases of congenital absence of one kidney found the corresponding ureteric orifice absent in all but fifteen. Horand[3] reported a case, the only one in literature, in which a ureter, arising from the side on which there was no kidney, passed across the middle line and drained the solitary kidney on the opposite side of the body. On the side of the kidney there was a ureteral orifice in the bladder, but the upper part of the ureter was wanting.

[1]Surgical Diseases of the Kidney and Ureters, London, 1901, p. 39.
[2]Virch. Archiv., 1895, vol. 141, p.
[3]Lyon Méd., 1905, vol. 104, p. 718.

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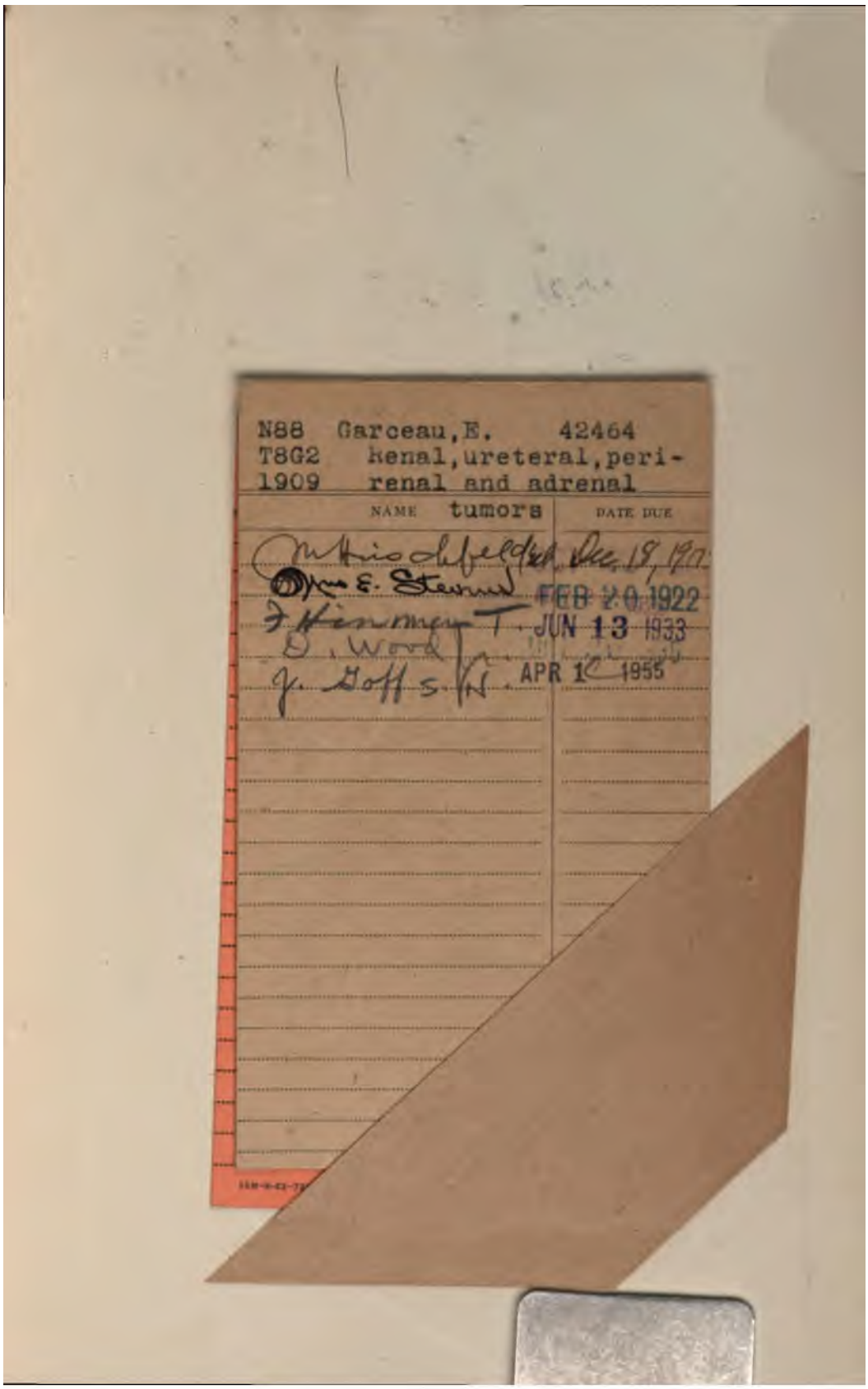
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